The FOUNDRY

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# Cleveland Draws Large Crowd

## Twenty-Seventh Convention Characterized by Large Attendance and Keenest Interest in the Exhibition and Technical Sessions

CLEVELAND welcomed the American Foundrymen's association for the third time when the doors of the new Public auditorium opened for the exhibition on April 28. Both floors of the auditorium were filled materially with exhibits of foundry equipment and supplies and the confidence of the industry in the present era of prospering was indicated by the large number of orders and inquiries for equipment placed. Few out-of-town visitors were in attendance on Saturday and the exhibits were given over to the local foundrymen who attended in large numbers. The great influx of visitors began early Monday morning and the registration booth was busy from that time until the last day. The total number in attendance passed the 4000 mark according to estimates by the secretary's office. The serious business of the technical sessions was relieved by an evening at the new Keith's Palace theater which was leased Tuesday evening for the foundrymen by the entertainment committee of the local foundrymen and equipment manufacturers. After an enjoyable vaudeville performance a dance was held on the stage. Wednesday evening after the banquet at which Gen. Henry T. Allen spoke of conditions in the Ruhr district, dancing was again in order. Some of the foundrymen indulged in a golf tournament Tuesday afternoon and the ladies had special entertainment in rides and luncheons Tuesday and Wednesday.

GULLIAM H. CLAMER
The New President of the American Foundrymen's Association Is Prominently Identified with the Nonferrous Branch of the Industry

All of the technical sessions were unusually well attended and those present showed a keen interest in the papers presented and entered freely into the discussions. Probably the greatest interest was shown in the sessions on molding sand where the results of the investigation of the joint sand research committee, which has done such a great volume of work on the subject, was reported. The sessions on new developments also attracted unusual interest, centrifugal casting and the long-life mold forming the chief features. Two topics which were less prominent this year than in previous years were discussed on electric furnaces and on gray iron. Only one session was devoted to electric furnaces. A large number of papers were presented at the two steel sessions and more information was brought out on the question of heat treatment of steel castings, which is a comparatively new subject for the average foundryman. The tunnel kiln furnace, which recently has been introduced into a number of malleable iron foundries was discussed at the malleable session and figures were given to show

how the length of the anneal has been shortened by using this type furnace.

One of the joint sessions of the institute of metals division of the Institute of Mining and Metallurgical Engineers and the American Foundrymen's association was devoted entirely to the subject of melting and casting aluminum, following a precedent established the past year at Rochester. The necessity of devoting at least one-third of the available time of the nonferrous sessions to the study of aluminum and its alloys is significant of the enormous and ever-growing importance of this light weight white metal in its cast form.

In late years the nonferrous program has been materially shortened. It is now compressed into two days, thus permitting members attending to return quickly to their regular duties, or devote time to an inspection of the many objects of interest presented at the exhibition of foundry appliances.

## Gulliam H. Clamer

Guilliam H. Clamer, who ranks among the foremost metallurgists in the nonferrous industry, was advanced from the vice presidency to the presidency of the American Foundrymen's association. He was born in Philadelphia 46 years ago, where he is now located as first vice president and general manager of the Ajax Electrothermic Corp. For two years after he was graduated from the public schools of Philadelphia he worked in the private chemical laboratory of Dr. F. A. Genth. He then entered the University of Pennsylvania and completed the chemical course in 1897. He immediately became affiliated with the Ajax Metal Co. in the capacity of chemist, being one of the first chemists employed in the nonferrous foundry industry. In 1898 he began the study of metallography in which field he also was a pioneer. Mr. Clamer was presented the Elliott-Cresson gold medal, the highest award of the Franklin institute, for his accomplishment in developing a process for eliminating zinc, aluminum, iron and other metals electropositive to copper, tin and lead from alloys containing all of these metals. Also, he has been associated with Dr. Carl Hering, James Wyatt and Dr. Edwin F. Northrup in the development of electric furnaces. Mr. Clamer for a long time has been actively engaged in the affairs of scientific societies; he is a past president of the American Society for Testing Materials, of the American Institute of Metals, now the institute of metals division of the American Institute of Mining and Metallurgical Engineers, and of the committee on science and arts of the Franklin institute. He also is active on numerous committees of these societies.

This is the second year that it has happened that one of the contributors of papers has not lived to enjoy its presentation. Last year T. A. H. Eastick was the victim of a falling icicle in Montreal after his paper was in the hands of the committee, this year, Jacob J. Kasjens, Peoria, Ill., has passed away. His paper on the casting of bronze tablets was scheduled for the second joint meeting on Tuesday morning, May 1.

The first paper on the program at the aluminum meeting was by Robert J. Anderson, entitled "Linear Contraction and Shrinkage of Some Aluminum Alloys." Junius D. Edwards and Cyril S. Taylor contributed a paper on the density of magnesium from 20 to 700 degrees, Cent. Their determinations are the first to be made on the density of the liquid metal. The manner in which the densities were determined, the apparatus and precautions used and difficulties encountered are given at length. These densities vary from 1.7388 at 20 degress Cent, to 1.478 at 822 degrees Cent. The crystalline shrinkage of magnesium in passing from liquid of density 1.572 to a solid of density 1.642, at the melting point is about 4.2 per cent, compared with 6.6 per cent for aluminum. The rate of expansion of liquid magnesium appears to be somewhat greater than that of solid metal; a high rate of liquid expansion is to be expected on account of the relatively small interval between the melting point of 650 degrees, Cent., and the boiling point of the metal.

The annual exchange paper of the Association Technique de Fonderie entitled "Recent Progress in the Application of the Aluminum Alloy Alpax in the Foundry," was presented by M. de Fleury of France. Mr. de Fleury is greatly interested in alloys of aluminum and has presented a number of papers on this important subject, notably on before the French foundrymen's association, also on alpax, in which he details the possibilities of the 13 per cent silicon, 87 per cent aluminum alloy, which forms the subject of the present paper.

One of the papers of this session dealing with the practical handling of aluminum in making castings was presented by W. A. Mills, of the Alloy Foundry & Machine Corp., New Rochelle, N. Y. Mr. Mills, who has been successful in making castings of aluminum in the shape of automobile radiator shells, mentions that such castings have been the source of much trouble to foundrymen owing to the difficulty of getting castings completely run and free of pin holes, and follows this with some practical suggestions for overcoming the difficulties mentioned.

He states, "The equipment required to cast aluminum radiator shells will depend entirely upon the production required. If this is not large a single aluminum pattern mounted on a follow board, and two or three wooden

H. B. SWAN

## New A. F. A. Officers

**President**

G. H. Clamer, Ajax Metal Co., Philadelphia.

**Vice President**

H. B. Swan, Cadillac Motor Car Co., Detroit.

**Directors**

L. L. Anthes, the Anthes Foundry, Ltd., Toronto, Canada.

T. S. Hammond, Whiting Corp., Harvey, Ill.

A. E. Howell, Somerville Stove Works, Somerville, N. J.

C. R. Messinger, Chain Belt Co., Milwaukee.

T. W. Pangborn, Pangborn Corp., Hagerstown, Md.

## H. B. Swan

H. B. Swan, who has been elected vice president of the American Foundrymen's association, is a prominent foundryman of Detroit, where he is foundry superintendent of the Cadillac Motor Car Co. He was born in that city and educated in its public schools from where he went to the University of Michigan, being graduated from the chemical engineering course of that institution in 1909. Mr. Swan, on leaving the university began work as a chemist in the laboratory of Diack & Smith, Detroit, where he stayed only a few months before going to Buffalo to accept a position as chemist and metallurgist for the Lumen bearing Co. In November, 1910, he returned to Detroit to work in the engineering department of the Alden Sampson Co., a division of the United States Motors. This was his introduction to the automobile castings field and when he had the opportunity to learn more of the production end, in November of 1911, he left his position with the Sampson company and started to work as a coremaker in the foundry of the Cadillac Motor Co. under the guidance and direction of J. J. Wilson, then superintendent of foundries of that company. The following year after having had experience in all departments of the foundry, he became Mr. Wilson's assistant. In 1919, when Mr. Wilson was transferred to the new foundry of the General Motors Co. at Saginaw, Mich., Mr. Swan became foundry superintendent of the Cadillac Motor Car Co. Mr. Swan has assisted in spreading foundry information by contributing numerous papers on foundry subjects at the conventions of the American Foundrymen's association and as a vice president and a director of the association in past years has helped to direct the course of the association.

flasks, will be sufficient. It is good policy to cast these shells with the surface to be polished in the drag, in which the sand should be rammed fairly soft, and before placing on the cope, the pattern should be rapped to loosen it in the sand of the drag and enable it to be lifted with the cope and not break the mold. Few, if any, gaggers will be required if the cope of the flask has been well barred. The cope should be rammed harder than the drag, then the pattern can be easily lifted in the cope. After the mold has been poured it should be shaken out as soon as possible to prevent cracking of the casting.

"When a large production is required, two rollover jolt pattern draw machines are necessary, one for the drag and one for the cope. Well-ribbed and barred, interchangeable aluminum flasks have been found most satisfactory because of their lightness and durability. With two men on each machine a large production can be obtained. As to the molding sand, no special grade is necessary, although the following mixture will produce smooth castings:

**SAND MIXTURE FOR FINE ALUMINUM CASTINGS**

Albany No. 00 molding sand.....1/3 part
Windsor Locks sand.....1/3 part
Used molding sand.....1/3 part

The molding sands should be mixed when in dry state and be tempered with water to the regular molding sand degree of dampness.

"Many suggestions have been offered regarding the proper alloy of aluminum for use in radiator shells, but experience has shown that an alloy of 94 to 95 per cent aluminum and 5 to 6 per cent of copper gives the best results in the shape of high polish and a dense casting. The use of scrap aluminum involves the foundryman in various troubles, such as porosity, cracked shells and a poor finish generally when the castings are polished. If aluminum-zinc alloys are used, small pin holes will show after the polishing operation, as the metal must be poured at quite a high temperature for aluminum due to the thinness of the castings. The method of gating is important. Satisfactory results have been obtained, pouring with two crucibles or ladles, one at either end of the mold, using gates shaped like a horse shoe or crescent, as shown in the accompanying illustration. On the long side of the castings two small risers are placed opposite each other to relieve the strain on the mold. The metal should be poured as cool as possible, forcing it into the mold. The temperature can not be given accurately, as this will vary with the thickness of the shell. When possible a pouring temperature of 1250 to 1300 degrees Fahr., should be used. It is good practice also to cover the metal when melting and to avoid all chance of its being overheated.

"Several shells are being manufactured that are so difficult to cast that production is out of the question, therefore, it is good policy for the foundryman to work with the automotive engineers with the object of designing a shell that will be practical to cast on a production basis."

## Established Record

Beginning an hour behind schedule owing to the lengthy discussion on the problems of sand research in the preceding session, the business meeting, when finally called to order by President Messinger late Tuesday afternoon, proved to be the shortest on record in the history of the association. Reports of officers, readings of minutes and all other formalities were dispensed with, leaving the announcement and election of officers and honorary members as the only business transacted.

C. R. Messinger, retiring president, was elected to honorary membership in recognition of his services to the association during his term of office. The same honor was accorded Dr. George K. Burgess, newly appointed director of the United States bureau of standards, for his co-operation with the committees of the association on technical matters, and to Dr. H. Reis, Cornell university, for the important work he has done in conjunction with the committees on sand research.

The two papers first read met with no discussion. The exchange paper proved of considerable interest, but it was felt that inaccuracies had crept in during transcription from the original French to English. Mention is made in the paper of the use of this alloy for bearings, and a mild discussion arose with the consenus of opinion favoring the belief that the moving machine parts did not actually run on the aluminum alloy but on a babbitt filling, the aluminum alloy being used for the retaining shell in the same manner as cast iron is so frequently employed.

The babbitt used in Germany in this connection is called Lurgi metal which is similar to what is known here as Frary metal, an alloy of lead with 1 or 2 per cent of barium. However, any suitable babbitt can be used in connection with aluminum-silicon alloys. This series of alloys may contain from 11 to 14 per cent of silicon, and the balance aluminum. They are rendered homogeneous by the use of a combination of salts comprising a special flux, and upon the use of which the patent is said to be based. Alloys of lower silicon content, notably one with 5 per cent of silicon are also in use, but can be made without the use of fluxes.

Such alloys usually contain some copper in addition to the silicon. The high silicon alloys are noted for their risistance to salt water corrosive influences. Also they are quite easy to cast because of low shrinkage and freedom from cracking.

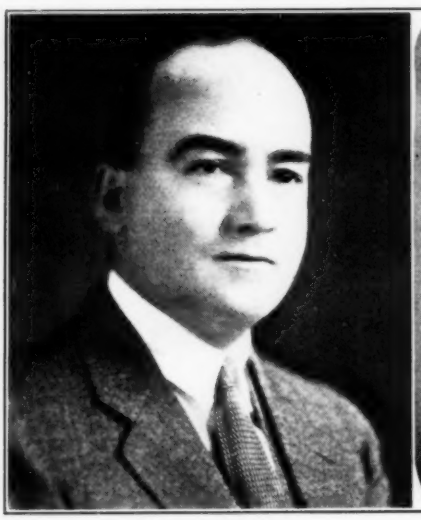
The second joint session on nonferrous subjects, held Tuesday morning, May 1 was devoted to the brass and bronze alloys, and included paper on melting and pouring temperatures of brass and bronze; casting bronze tablets; the contraction and shrinkage of nonferrous alloys, and the effect of heat-treatment in releasing stresses in bronze castings. As most of these papers are of sufficient importance to be published in full in future issues of THE FOUNDRY only the outstanding features of one or two will be given consideration at this time. The paper dealing with the molding of bronze tablets was prepared by Jacob G. Kasjens, Brass Foundry Co., Peoria, Ill., since deceased, and is of an eminently practical nature. Mr. Kasjens was a practcial molder of the old school, and had given much study to the casting of tablets and some fine examples of his skill are to be found as part of the Soldier's monument in Court House square, Peoria, and are described in the May, 1918, issue of THE FOUNDRY, pages 216 and 217. The present paper gives details regarding the preparation of the facing sand, and the method of ramming the molds. For a tablet 20 x 30 inches a flask 35 x 40 inches inside measurement should be used. The drag should be 6 inches deep and the cope 4 inches deep, and if the flask is made of wood, the lumber should be 3 inches thick, and the corners of the flask must be well braced by angle irons. A tablet of this size should be poured from two pots at opposite sides of the casting. The gates consist of runners extending the length of the sides of the plate and a short distance away therefrom, with gates connecting the

# Foundrymen Elect Five Directors

CONTINUAL change in the personnel of the board of directors of the American Foundrymen's association is provided by the by-laws which require the election of five of the fifteen directors every year. Thus five directors are elected to a three year term, while a portion of the board is new every year. This year only one of the retiring directors was re-elected for three years.

C. R. MESSINGER

ALFRED E. HOWELL, who has been re-elected to the board of directors, is well known to foundrymen, having served the association in a number of capacities since he became a member in 1909. At this time he was superintendent of manufacture for the Philips & Buttorff Mfg. Co., Nashville, Tenn., and in the same year was elected a vice president of the association, representing the southern district. He served in this position until 1913 when he was elected president of the association. Since retiring from this office he has continued active in the affairs of the association, serving continuously as director, as a member of the board of awards, on the advisory boards, and a number of committees. Leaving the South about four years ago he came to Somerville, N. J., to become general manager of the Somerville Stove Works, which position he now holds. Mr. Howell, since graduating at Vanderbilt university, Nashville, Tenn. has been widely interested in educational and public affairs.



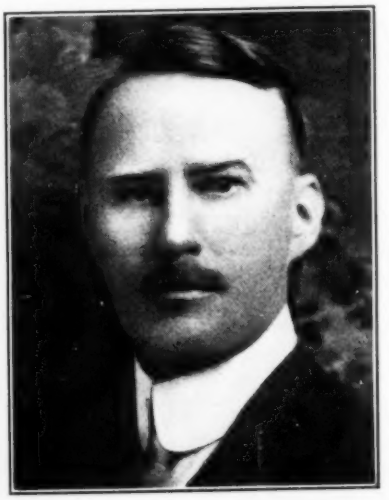
T. W. PANGBORN

ALFRED E. HOWELL

T. S. HAMMOND

THOMAS W. PANGBORN, president of the Pangborn Corp., Hagerstown, Md., was born in Brooklyn, N. Y., in 1880, and has been affiliated with the foundry industry from the time he first engaged in business. In 1900 he started as salesman for Hendricks Brothers, New York, wholesale metal dealers, and continued with them until 1904 when he started business for himself, specializing in sand blast and allied equipment. Besides being president of the Pangborn Corp. he is also president of the Washington County Manufacturers' association and of the Hagerstown Home Corp. Also, he is a director of the Maryland Surety & Trust Co. and of the Foundry Equipment Manufacturers' association, and a member of the American Society of Mechanical Engineers.

C. R. MESSINGER, retiring president of the association, has been retained on the board of directors. Mr. Messinger was graduated from the Sheffield Scientific school, Yale university, in 1906. Immediately upon leaving school he became representative for the Harbison-Walker Co., in Pittsburgh and Chicago. In 1909 he joined the organization of the Sivyer Steel Castings Co., Milwaukee, and was made secretary and general manager. Later he was advanced to the position of vice president and general manager, and in 1917 was made vice president and general manager of the Chain Belt Co., Milwaukee, with which company he had been identified since 1912. Mr. Messinger also is president of the Interstate Drop Forge Co., and vice president of the Federal Malleable Co., both of Milwaukee. He was elected a director of the American Foundrymen's association in 1918, and in 1920 was made vice president of the association, advancing to president the following year. Mr. Messinger's other affiliations of a technical and business nature include membership in the American Society of Mechanical Engineers, and director Electric Steel Co., Chicago.



L. L. ANTHES

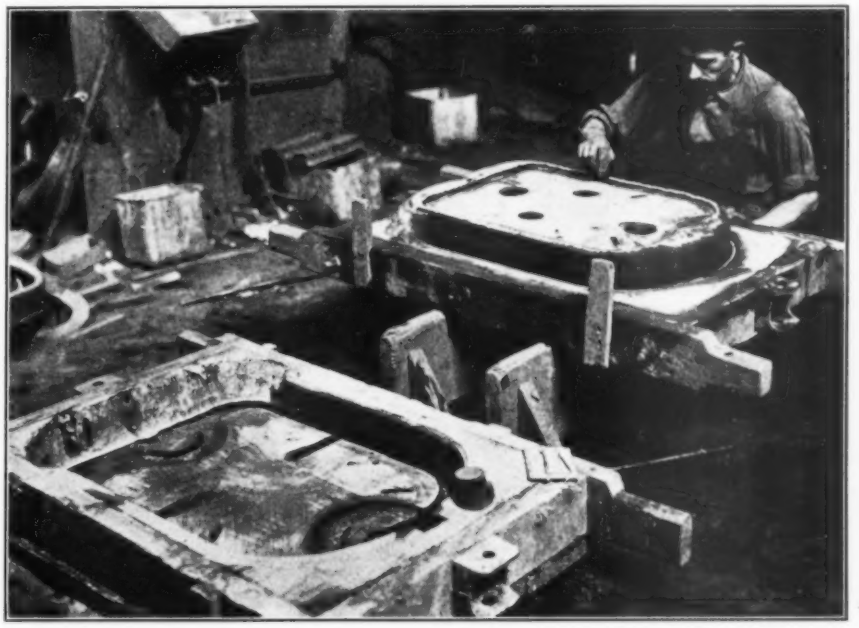
T. S. HAMMOND was born at Crown Point, N. Y., in 1884. He attended high school in Chicago and was graduated from the University of Michigan in 1906. After leaving college he entered the employ of the Whiting Foundry Equipment Co., Harvey, Ill., now the Whiting Corp., of which he has become vice president and secretary. He also is president of the Swenson Evaporator Co., and is secretary of the Grindle Fuel Equipment Co., both subsidiaries of the Whiting Corp. Mr. Hammond is active in other foundry associations, being vice president of the Foundry Equipment Manufacturers' association, a member of the executive council of the National Founders' association and a member of the National Metal Trades association. Retaining his interest in his alma mater he is president of the University of Michigan Association of Chicago, and of the "M" club. Being connected with the Illinois National guard for a number of years, he served on the Mexican border in 1916, and with the 149th field infantry in France.

LAWRENCE LEE ANTHES, former president of the American Foundrymen's association, is a Canadian, being born at Toronto in 1876. At the age of 20 years he entered service of the Toronto Foundry Co., joining his father in the manufacture of cast iron soil pipe and fittings. In 1899 he left the foundry to take up journalism, but rejoined the Toronto Foundry Co. in 1902, in the capacity of superintendent. In 1908 the firm name of this company was changed to the Anthes Foundry, Ltd., and in 1912 the company erected a second plant at Winnipeg, Can. Upon the death of his father, Mr. Anthes became managing director and secretary-treasurer of the company. Mr. Anthes was vice president of the American Foundrymen's association during the 1906-1907 term, and president from 1908 to 1909. He is also alumnus member of the National Founders' association and was chairman of the Toronto & Ontario branch, Canadian Manufacturers' association, 1917-1918.

castings at intervals 1½ inches apart. These gates should be ⅝-inch wide and ⅜-inch deep. As the molds are skin dried, it is necessary to spray them with molasses water mixed with the aid of heat in the proportion of one part molasses to 15 parts water. For a tablet 20 x 30 inches, from one to two quarts of the spray already mentioned should be misted onto the drag, and about half that quantity on the cope.

The paper on the effect of heat treatment on the release of stress in bronze castings, by Robert J. Anderson, proved interesting, and the question was asked if such heat treating would correct the difficulty of the warping of flat disclike castings after being machined and stored. It was considered that annealing for 1 hour or more at a temperature of around 600 degress, Cent., would release the stresses and thus correct this difficulty. Instances were brought up where heat treatment had corrected leakage defects in brass castings, but a more certain method of preventing leakage in such an alloy at 88-10-2 was thought to be the addition of 1 per cent lead in place of a like amount of copper.

Much discussion followed the presentation of the paper, "Notes on the Proper Pouring and Melting of Brass and Bronze," by F. L. Wolf and W. Romanoff. This paper was eulogized by the chairman G H. Clamer, as the most practical paper ever presented before the Institute of Metals. Some of the statements made in the paper, however, provoked considerable discussion of a friendly nature; statements with regard to fluxes being questioned to the end that it was decided these aids to the melter had their proper sphere of usefulness, that while under certain conditions they might be dispensed with, under other conditions they were a necessity . The statement also made that silicon should never be used where electrical conductivity is essential was disputed, but it is doubtful if those who questioned this statement fully understood the meaning of the authors, which is taken by THE FOUNDRY to be that when sufficient silicon is added to ensure sound copper castings in the case of copper melted in the usual manner in brass furnaces, the resulting castings will be low in electrical conductivity, a statement susceptible of proof. While copper of high electrical conductivity can be made using silicon, either the copper must be treated before the addition is made, in a manner to reduce oxides and permit a minimum of silicon being added, or the silicon alloy used must be mixed with some element that will combine with excess silicon to form a nonmetallic body which seperates from the copper. Thus one member objecting to the statement about the bad effects of silicon on copper conductivity had in mind the effect of an alloy of copper, silicon and calcium, which is entirely different, as the calcium combines with the excess silicon left in the copper and forms calcium silicate, a nonmetallic body which rises to the surface of the copper bath and is skimmed off, or later is found in the casting itself.



MOLDS FOR AUTOMOBILE RADIATOR SHELLS ARE POURED FROM BOTH ENDS USING GATES SHAPED LIKE A CRESCENT OR HOSESHOE

The paper dealing with the briquetting of brass turnings detailed experiments of a negative nature, and after some discussion the opinion was expressed that the size of the briquettes now being made was much too large.

# New Developments Are Outlined

DISCUSSION of the development in the centrifugal method of making iron castings and the progress that has been made toward effecting a permanent mold featured the session Wednesday afternoon on new developments in the foundry industry. John A. Rathbone, Detroit, Mich., discussed the problems he had encountered in the centrifugal casting of iron piston rings. Mr. Rathbone stated that the greatest problem in this field is to find a metal for use as a permanent mold that will withstand constant heating and cooling without chipping.

Leon Cammen speaking on "Centrifugal Casting" stated that this method furnishes a revolution in the art of steel making. Calling attention to the fact that great progress has been made in steel making since the day of Bessemer, he said that today, however, we are using the same methods in the casting of metals that were used years ago. He stated that great economy in labor has been found in the use of the centrifugal method of making castings but pointed out that exact machines are required in this process, with much stress being laid on the weight of the machine, the lack of vibration, perfection in design and absolute temperature control. "British Foundry Practice—Ferrous and Nonferrous," the annual exchange paper by Percy Longmuir, Institution of British Foundrymen, was read by R. S. McPherran, Allis-Chalmers Mfg. Co., Milwaukee.

Speaking of the desulphurization of cast iron, Richard Moldenke, Watch-

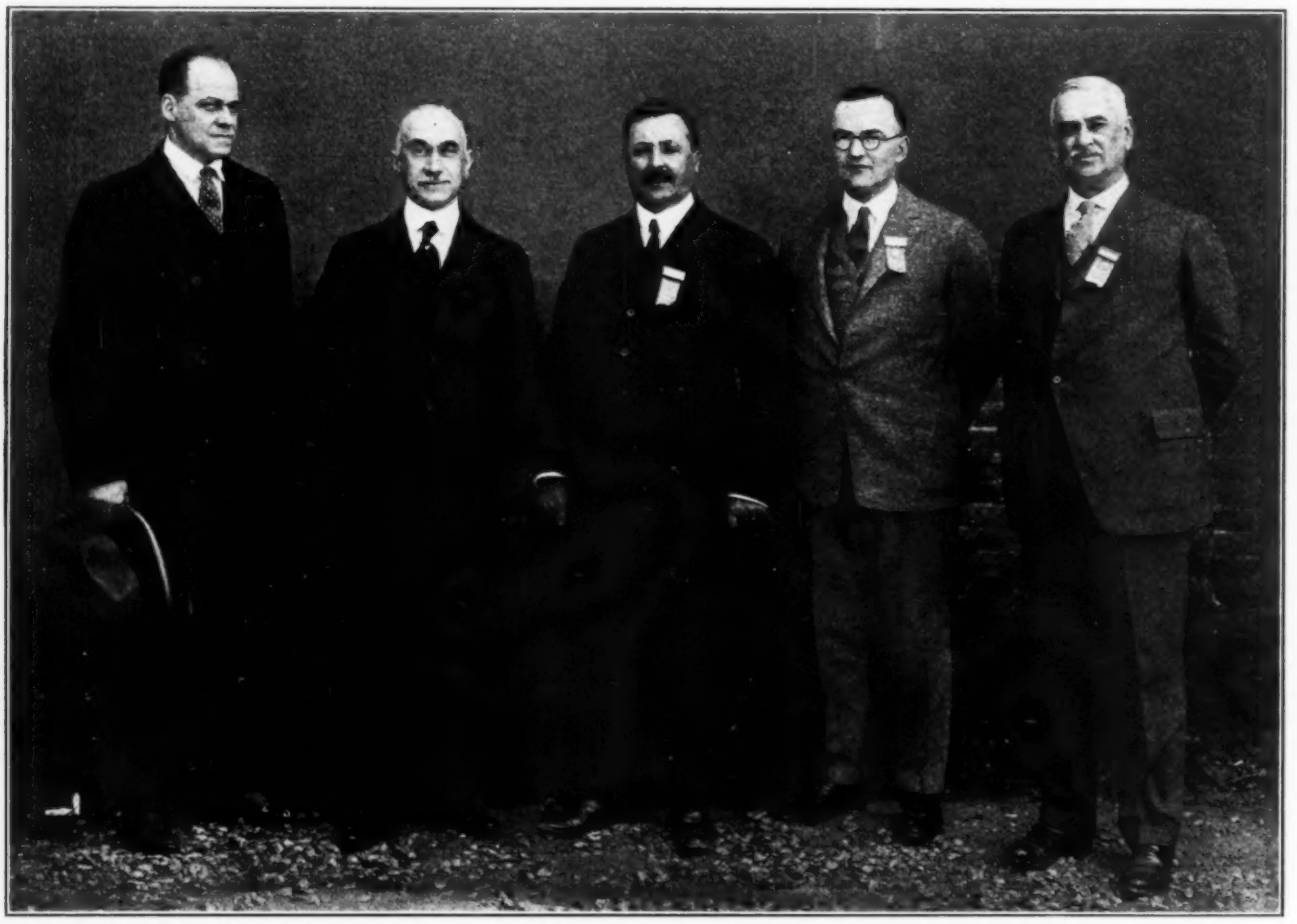
ung, N. J., discussed several means of reducing the sulphur content of iron. He stated that three methods are in use for reducing sulphur, namely the addition of a larger amount of pig iron, use of the basic electric furnace and the use of chemical methods. Dr. Moldenke recommended the addition of soda or potash on top of the ladle as the desulphurizing agent. He stated that a churning motion seems to take place inside the ladle upon application of this compound since the sulphur remains uniform through the entire mass of metal.

One of the interesting features of this session was the discussion on long-life mold development by Dr. Moldenke. He stated that three considerations must be given attention in the development of long-life molds, namely the refractory character of the mold surface, nature of mold surface to eliminate formation of gases, and the nature of the mold surface to resist the cutting action of the metal. He described the installation at the Holley Carburetor Co., Detroit, where a successful mold is in use. This paper is printed in full elsewhere in this edition.

Synthetic foundry iron may be made in the electric furnace at a total cost figured in the ladle at the foundry at $30 per ton, according to C. E. Sims of the United States bureau of mines, Seattle, who delivered one of three papers on the general subject of the electric furnace in the foundry at the technical session Tuesday morning. The paper which Mr. Sims read was jointly compiled by C. E. Sims, C. E. Williams and B. M. Larsen, all of the Northwest experiment station of the bureau of mines. The paper describes the production of cast iron from almost any kind of ferrous scrap by the use of a carburizer. It is pointed out that the chief features to observe in this process are intimate contact between the carburized and the metal, and the use of high temperature. A dense pure form of carbon is recommended for the carburizer. This is charged under the metal and the melting begins at the bottom. The paper developed lively discussion and, together with the other papers of the session, aroused sufficient interest so that a resolution was adopted recommending to the papers committee of the American Foundrymen's association a continuance of the same subject in a further group of papers to be presented at the next Foundrymen's convention. It was suggested that these be prepared with special reference to the value of alloy additions.

A paper on the electric furnace from the manager's standpoint, prepared by L. J. Barton, Dibert, Bancroft & Ross, Ltd., New Orleans, in the absence of Mr. Barton, was read by E. F. Cone, Iron Age, New York. The paper reviewed the arguments concerning the economy of electric furnace iron. It is shown that in some localities direct comparison gives the electric furnace some advantage over the cupola but in other localities the indirect advantages of the furnace must be considered, and these are often more important than generally understood.

G. K. Elliott, Lunkenheimer Co., Cincinnati, in a paper on gray cast iron from the electric furnace outlines



THE CONVENTION WAS HONORED BY THE ATTENDANCE OF M. EMILE RAMAS, PRESIDENT 'L ASSOCIATION DE TECHNIQUE DE FONDERIE OF FRANCE

Left to Right, Mr. Swan, Vice President, and Mr. Clamer, President of the American Foundrymen's Association, M. Ramas, Fred Erb and S. T. Johnston, Directors of the American Association

the main features of the acid and basic electric furnaces, and then sketches the general operating features of both the cupola and the electric furnace.

The use of gray iron in automotive work together with various points were featured in the session on gray iron, Thursday morning. In a paper on "Notes on Gray Iron for Automotive Castings," by H. B. Swan, Cadillac Motor Car Co., Detroit, data obtained from replies to a questionnaire sent to 25 automotive castings plants were presented. Mr. Swan also gave tabulated data on iron mixtures and cupola practice in producing cylinders, pistons, crankcases and various small castings. The effect of carbon and other elements on the physical properties of automotive castings was reviewed and practices at the various plants furnishing data were compared. During the discussion it was suggested that the standards of the American Foundrymen's association on coke should be enlarged, covering the quantity and kinds of coal used in the coking, and the time and the temperature of coking. Along the same line it was also suggested that the specifications of the American Foundrymen's association should contain a more complete analysis of pig iron.

E. J. Lowry, Hickman-Williams Co., Cincinnati, presented a progress report on the work of the committee investigating the advisability of an International test bar. This matter will be taken up at the June meeting of the American Society for Testing Material in Atlantic City and will then be presented by members of the committee at the International Foundry exhibition at Paris in September. R. S. McPherran, Allis-Chalmers Mfg. Co., Milwaukee, also presented a progress report of the committee on specifications for cast iron.

W. J. Bolton, the Niles Tool Works, Hamilton, O., presented a paper in which he discusses the quality of materials as an important factor in making castings and stated that graphite flakes influence quality. He also stated that the question of high or low carbon depends on individual condition, with most foundrymen favoring low total carbon. Much of the discussion following this paper revolved around the subject of the amount of sulphur allowable in castings. It was the consensus of opinion that the total percentage of sulphur could be increased without seriously injuring the quality of the final casting.

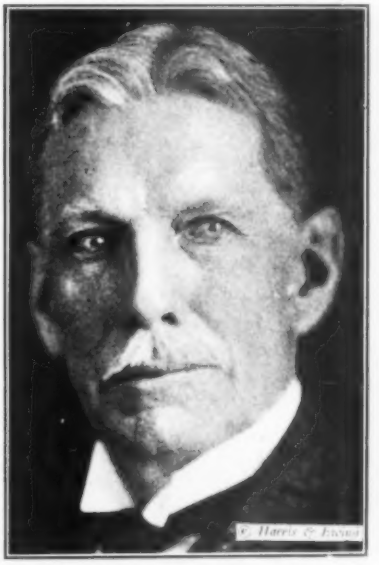
Speaking on "Visual Observations of Melting in a Cupola," John Grennan, University of Michigan, Ann Arbor, Mich., discussed conditions in a cupola as observed through holes cut in the cupola shell. Six holes 6 inches apart were made through the shell and lining and the condition of coke and iron during the melting process was recorded. Mr. Grennan states that the upper tuyeres are undesirable, that the stack should be of as even thickness as possible, that coke of uniform size should be used, and that it is possible to improve the quality and uniformity of cupola iron by future study of the melting process. It was stated in the discussion that a standard for cupola practice would be altogether possible and desirable since it would tend to produce castings of a more uniform quality. O. A. Backert, the Penton Publishing Co., Cleveland, was chairman of the meeting.

# Industrial Education Topic

ALTHOUGH the subject of industrial education has received much attention at recent meetings of the American Foundrymen's association, it is doubtful whether it ever was more thoroughly discussed than at the session held Tuesday morning. With Dr. Richard Moldenke, Watchung, N. J., presiding as chairman, representatives of many manufacturers and federal and state educational institutions presented papers and discussed the problem of training foundry workers.

Perhaps the most complete outline of a successful apprenticeship system for foundry workers was given by H. F. Frommelt, Falk Corp., Milwaukee. Mr. Frommelt described the circumstances surrounding the inauguration of the apprenticeship system and explained that in the few years since the war, the course has become so popular that, despite the fact that there are many competing foundries in the neighborhood, there actually is a waiting list of young men desiring to be enrolled in the course at this foundry. In the discussion of Mr. Frommelt's paper, several speakers emphasized the fact that the success of any apprenticeship system depends on the amount of thorough training and experience given the apprentice. They explained that the average boy appreciates a good opportunity to gain experience

## Asks Participation



MAJ. GEN. HENRY T. ALLEN

*URGENT plea that the United States take a more active part in world affairs was voiced by Maj. Gen. Henry T. Allen, commander of the American forces in Germany, speaking at the annual banquet of the American Foundrymen's association, at the Hotel Cleveland, May 2. He said in part:*

*"The United States has moved from the position of a colonial nation to that of the dominant economic power of the world. Our strength and prestige are such that it is our responsibility to take a more active part in world affairs. From a selfish as well as an altruistic standpoint it is our duty to be interested in what is going on about us. Like dwellers on the top floor of an apartment house we are interested in stopping someone from dynamiting the lower floors. If we stand aloof who can tell when again we may be forced into conflict with some other states which may make decisions unknown to us. If we had participated more fully in the momentous European affairs of the past four years our own welfare would be better today and the serious situation now obtaining abroad would not now exist. I most strongly urge that the United States use its great power for good to work for the good of the world."*

*General Allen traced developments in Europe after the armistice, explaining the conflicting French and German viewpoints which led up to the occupation, which he describes as the greatest economic war of modern times, and which he says has brought untold suffering to hundreds of thousands in the occupied region.*

more than he does a little higher monetary reward during the period of training. Others who described apprentice systems in industrial plants were C. M. Morrin, Brown & Sharpe Mfg. Co., Providence, R. I.; L. W. Klein, Coxe Traveling Crane Co., Port Carbon, Pa.; F. W. Kirby, Deere & Co., East Moline, Ill.; E. A. Parker, Springfield Aluminum Plate & Casting Co., Springfield, O. C. C. Hayward Co., Milwaukee.

The remarks of these speakers were supplemented by those of representatives of the federal and state institutions. Among those who participated were W. F. Simon, Industrial Commission of Wisconsin, Madison, Wis.; L. A. Hartley, Nebraska Department of Vocational Education, Lincoln, Neb.; A. B. Mays, University of Illinois, Urbana, Ill.; J. Grennan, University of Michigan, Ann Arbor, Mich.; A. L. Williston, Wentworth institute, Boston, Mass., and O. W. Potter, University of Minnesota, Minneapolis, Minn.

Mr. Grennan urged that foundrymen rotate molders from one job to another in order that they may have a more general knowledge of molding. Several speakers questioned the advisability of this plan, stating that in some cases it would be almost impossible to change a man who had become expert on some particular job to another kind of work with which he was not familiar. The chief objection, it was pointed out, would be that in a shop where piece work is in vogue, the man changed would suffer a great reduction in his income until he masters the new work. Constant rotation, it was pointed out, would seriously lower his earning power.

John H. Shaw, Sargent & Co., New Haven, Conn., spoke briefly of the difficulties encountered in the foundry industry under the present conditions of employment in other industries. He stated that with various state highway departments paying as high as 65 cents an hour for common labor, it was difficult to obtain men for foundry work. This condition, he said, emphasizes the need of apprenticeship courses by which foundries may insure a supply of new workmen. The point was brought out by the other speakers that in order to keep an apprentice after he has been trained, the foundry where he has served his apprenticeship must have treated him so well and so firmly impressed him with a sense of loyalty that he will prefer to stay with the company after his term of training has been completed.

# Sand Draws Enthusiasm

ONE of the outstanding features of the convention was the attention and enthusiasm manifested in the sessions on molding sand research. The attendance of 300 foundrymen at the session on this subject Tuesday afternoon was followed Wednesday morning by a second session almost as well attended. The papers read, reports submitted, and the discussions indicate that the work is having a widespread influence, and that foundrymen in general are watching closely every step in the investigation.

The session held Tuesday afternoon was devoted almost entirely to the discussion of the methods of testing sand. R. A. Bull, research director, Electric Steel Founder's Research group, Chicago, who presided as chairman, introduced the program with brief introductory remarks covering the great amount of work that has been done by the joint sand committee. H. B. Hanley, Whitehead Bros. Co., Rochester, N. Y., as chairman of the subcommittee on sand testing presented reports on tests for bonding, fineness and permeability. In addition to these three standard tests he suggested that supplementary tests covering dye adsorption, chemical analysis and sampling be employed.

Following the presentation of these reports Dr. H. Ries, Cornell university, Ithaca, N. Y., presented a paper entitled "The Cohesiveness Test of Foundry Sand," by himself and C. M. Nevin, also of Cornell university. The authors discussed data which they obtained regarding the bonding strength of molding sand. In the investigation they used the methods described by R. J. Doty at the 1922 covention. However, the sand is rammed by a 20-pound weight dropped from a definite height instead of by the method described by Mr. Doty. The percentage water in the sand is shown to be an important factor in bond strength, and and in some sands a variation of 1 per cent in total moisture content gives a great difference in cohesiveness.

A paper dealing with physical test for foundry sand was read by Eugene W. Smith, Crane Co., Chicago. Following a general discussion of the testing of sand, Mr. Smith described the method of making the vibratory test. In brief this test consists of placing a 10 or 12 ounce glass bottle containing water and about ¼ full of sand on a foundry vibrator plate and vibrating it until the heavy grains are down. The bottle then is allowed to stand until the water becomes clear at which time the bond and silica will be found divided by a distinct line. By measuring the relation of the bond and silica to the total amount of sand the percentage of each may be easily determined.

The reports and papers brought forth an extensive discussion in which many of those who have been identified with the work of various committees participated. Among those who discussed the question were R. J. Doty, H. B. Hanley, Dr. H. Ries, R. A. Bull, R. F. Harrington, F. L. Wolf, A. A. Grubb, G. L. Stoddard and others. A number of speakers outlined their experience with the method of testing described by Mr. Doty at last year's convention and expressed their belief in its reliability. Others criticised some features of the tests advocated by the committee, but at the conclusion of the discussion it was apparent that while difference of opinion had developed the work and aims of those entrusted with the sand research investigation were more thoroughly understood than before.

The first part of the program Wednesday morning was devoted to the report of progress of the subcommittee on conservation and reclamation of molding sand. This report reviews the methods by which certain information on this subject was obtained from more than a thousand foundries, and concludes with a summary of the methods reported by these foundries.

Considerable attention was given to a paper entitled "Sand Conservation and Reclamation Tests Using the Doty Cohesiveness Testing Machine," presented by R. F. Harrington, W. L. MacComb, and M. A. Hosmer, Hunt-Spiller Mfg. Corp., South Boston, Mass. This paper is a survey of work performed in connection with the problem of sand conservation and reclamation. The objects of the tests were to determine the effect of moisture on the bond of new sand, the effect of hand mulling and machine mulling and the effect of grain size on the bond of the sand. The sands were tested by means of the bond testing machine described by R. J. Doty at last year's convention. The authors concluded that this apparatus if properly standardized is an excellent method for comparative testing, that a new sand dried out and remoistened to its original moisture content has a greater

strength than before drying, that all other factors being constant, the bond of molding sand varies as the grain size, and that machine mulling brings out to a more or less extent the active bonding materials as determined by the die adsorption test. F. L. Wolf, and A. A. Grubb, Ohio Brass Co., Mansfield, O., presented two papers, one devoted to the reclamation and conservation of brass molding sand and the other to the reclamation of core sand.

Other papers scheduled for this session were "Reclaiming Foundry Sand" by H. M. Lane, H. M. Lane Co., Detroit, and "Use of Chemical Reagents in Preparing and Rebonding Molding Sand" by H. W. Highriter, commercial laboratories, New Haven, Conn. Mr. Lane's paper is a review of work on reclaiming foundry sand covering an experience of many years. Mr. Highriter in his paper proposes as a field for investigation the addition of acids and alkalies in small quantities to molding sand heaps. The beneficial effects of certain alkalies is increasing the plasticity of clays have been investigated by research in the ceramic industry. A German practic also is cited which shows that the method is not without practical possibility.

Additional interest was attracted to the sand sessions by a small exhibit of sand testing equipment loaned by the Universiy of Illinois, W. S. Tyler Co., United States bureau of standards, the Sivyer Steel Casting Co., and others.

# Cover Malleable Broadly

A WELL attended session on foundry malleable problems was held Wednesday afternoon at 2 o'clock with H. A. Schwartz, director of research, National Malleable Casting Co., Cleveland, presiding as chairman.

In a paper by Philip Dressler, American Dressler Tunnel Kilns, Inc., Cleveland, a tunnel kiln for annealing malleable castings was described. In this paper the author refers to the initial discussion of the subject at the Milwaukee convention following a paper presented that time by H. E. Diller, metallurgical editor of THE FOUNDRY, showing some of the advantages to be obtained by the use of this type of furnace for annealing malleable iron. Mr. Dressler discussed the control of the time temperature curve in the continuous tunnel furnace for securing best results in annealing malleable castings. Various difficulties encountered in securing the best results from the refractories used are discussed, one of these being the use of oil with slight amounts of alkalies. It was found that a malleable known as *gas oil* is available and is free from alkalies. The author states that gas is the best fuel to use.

S. J. Felton, Ohio Mechanic Institute, Cincinnati, discussed the problem of producing malleable iron castings in small quantities. In this paper he describes the production of black-heart malleable in melting furnaces not ordinarily used for this metal. Mr. Felton concludes that although the arc electric furnace seems to be ideal for melting malleable a considerable investigation is needed to secure data to cut down the annealing time for malleable iron made by this process. In making small quantities of malleable the costs are high and difficulties are likely to be encountered unless an experienced man directs the work, especially when the plant is first placed in operation.

The important problem of keeping a check on malleable foundry scrap was discussed in a paper by E. D. Halsey, Terra Haute Malleable & Mfg. Co., Terre Haute, Ind. Mr. Halsey described a system whereby a committee composed of the superintendent, assistant superintendent, production manager and certain foremen daily inspect rejections for the purpose of salvaging castings and correcting wrong methods. Prof. Enrique Touceda, research director, American Malleable Castings Association, Albany, N. Y., presented the report of the committee on specifications for malleable castings, which was accepted. This report outlined the changes made in the specifications which were adopted at the meeting of the American Society for Testing Naterials in June, 1922.

A. V. Landschoot, Iowa Malleable Iron Co., Fairfield, Iowa, spoke on the application of fuel oil to the malleable air furnace. Mr. Landschoot admitted at the start that a number of difficulties face the malleable furnace operator who first attempts to use oil. However, he maintained these difficulties may be overcome, and outlined the method by which this fuel had been successfully used in one plant.

"Hardened and Tempered Malleable Castings" is the title of a paper presented by E. K. Smith, Lakeside Malleable Casting Co., Racine, Wis. This paper deals with the possibilities of hardening malleable castings for use as medium grade tools. After considerable investigation it was found that although no definite conclusions may be stated, the opportunities for developing a suitable method for hardening are encouraging.

# Steel Meetings Interest

AT the steel foundry session held on Monday afternoon, C. S. Koch, Fort Pitt Steel Casting Co., McKeesport, Pa., presided. "Production of Light Steel Castings for Ordnance Work," was the title of a paper presented by Major Minton, Watertown arsenal, Watertown, Mass. The speaker described the steel foundry practice in use by the government. A. D. Willaims, consulting engineer, Cleveland, read a paper, "Heat Generation in Open-Hearth Practice" in which he discussed fuels. He used the graphic method for comparing fuels and determining their applicability to various uses. As a rule, liquid and gaseous fuels are more desirable than the solid fuels. William McConway, McConway & Torley, Pittsburgh, presented a paper on "Centrifugal Casting of Steel." The mold and casting machinery were described by lantern slide sketches. Moving pictures were used to show how the steel is cast, revolved under hydraulic pressure until it is solidified, conveyed to the soaking pit and then broken down to the forging presses to produce various sections. H. W. Dietert, engineering experiment station, University of Illinois, Urbana, Ill., showed photomicrographs to illustrate the permeability, bond and nature of the casting surface of the sand. This method of sand study he said, offers possibilities for more intelligent preparation and reclaiming of sand.

A. H. Jameson, Plainfield, N. J., chairman of the steel castings committee of the American Foundrymen's association, reported for that committee. He said that last year a joint committee of the American Railway association and the American Society for Testing Materials prepared a draft of specifications for carbon steel castings for railroads. These specifications were approved by both organizations and adopted by the American Society for Testing Materials, at its June, 1922

meeting, as tentative standard A 87-22T. After a trial of one year the specification come up for discussion and probably final approval at the coming meeting of the society in June. Influenced by the above progress, the American Society for Testing Materials last fall began study of its own specifications for general steel castings. A subcommittee with A. H. Jameson representing the American Foundrymen's association suggested revisions to the standard specifications for steel castings, A 27-21. The recommendations were accepted by the committee and will be discussed and proposed for adoption at the June meeting of the of the American Society for Testing Materials. Mr. Jameson reported that the Federal specifications board has submitted to various federal departments and independent establishments a proposed draft of specifications for steel castings made and purchased by the government. The American Foundrymen's association was consulted in the drafting of these specifications. It is expected that the new specifications will be announced soon by the Federal specifications board.

One of the meetings on Thursday morning was devoted to steel foundry practices, A. H. Jameson, Plainfield, N. J., being chairman of that session. The first paper presented was the "Heat Treatment of Alloy Steel Castings," by H. A. Lorenz, Bucyrus Co., South Milwaukee, Wis. The author shows how heat treatment of steel castings emphasizes the good and bad qualities of the original casting, taking up such points as nonmetallic inclusions, dendritic structure and comparative density. Heat treating practice was described and data given of results on nickel-chrome steel castings.

"Heat Treatment of Steel Castings" was the title of a paper presented by H. A. Neel, Michigan Steel Casting Co., Detroit. The purpose of the paper was to point out the method used by the Electric Steel Founders' Research group to solve the problem of heat treating castings made by it. The standards laid down do not necessarily apply to heavier types of castings. For each class of steel castings the most successful practice must be worked out. This paper evoked much discussion, particularly on the results to be obtained by a variation in annealing temperatures.

C. S. Koch, Fort Pitt Steel Casting Co., McKeesport, Pa., read a paper entitled "Core Mixtures for Light Steel Castings." Mr. Koch presented the results of an investigation to reduce core costs for light steel castings. Two factors are to be considered namely, strength of core and cost. For the purpose of testing the cores a small tensile testing machine was developed. The permeability of the common sands used in core making was found to be satisfactory. Four binders were used in the tests; all oil, corn flour compounds, pitch compounds and paper mill by-products.

Major R. A. Bull, director, Electric Steel Founders' Research group, chairman of the committee on sulphur and phosphorus investigation, said the committee had nothing to report in the way of definite progress. C. N. Ring, Ohio Steel Foundry Co., Lima, O., made a report as chairman of the committee on refractories. This committee war organized recently and has done little work. It has arranged for a meeting soon at which manufacturers of refractories have been invited to send representatives. Standards will be proposed to the American Society for Testing Materials. The committee on ferrous castings, H. A. Neel, Michigan Steel Casting Co., chairman, reported that the committee was a new one and had had no formal meeting. However, he said, suggestions are being received as to the proper course for the committee to pursue.

## Plans for Visit

*To the Secretary, American Foundrymen's Association:*

*The council of the Institution of British Foundrymen has learned with much pleasure that it is the intention of a number of members of the American Foundrymen's association to attend the French exhibtion and conference in Paris in Sept.* 1923, *and that before proceeding to Paris they will spend a few days in London.*

*I am asked by the council and also on behalf of the Iron and Steel Institute and the Institute of Metals, to say that when our American friends are in London we shall give them a hearty welcome and be pleased to do what we can to make their visit to this country as interesting and enjoyable as possible.*

*I may add that arrangements will be made for the visitors from your side and those of our members who intend visiting the French exhibition and conference to travel in one party.*

*INSTITUTION OF BRITISH FOUNDRYMEN.*

W. G. Hollinworth,
General Secretary.

## Award Prize to Chill Car Wheel Rig

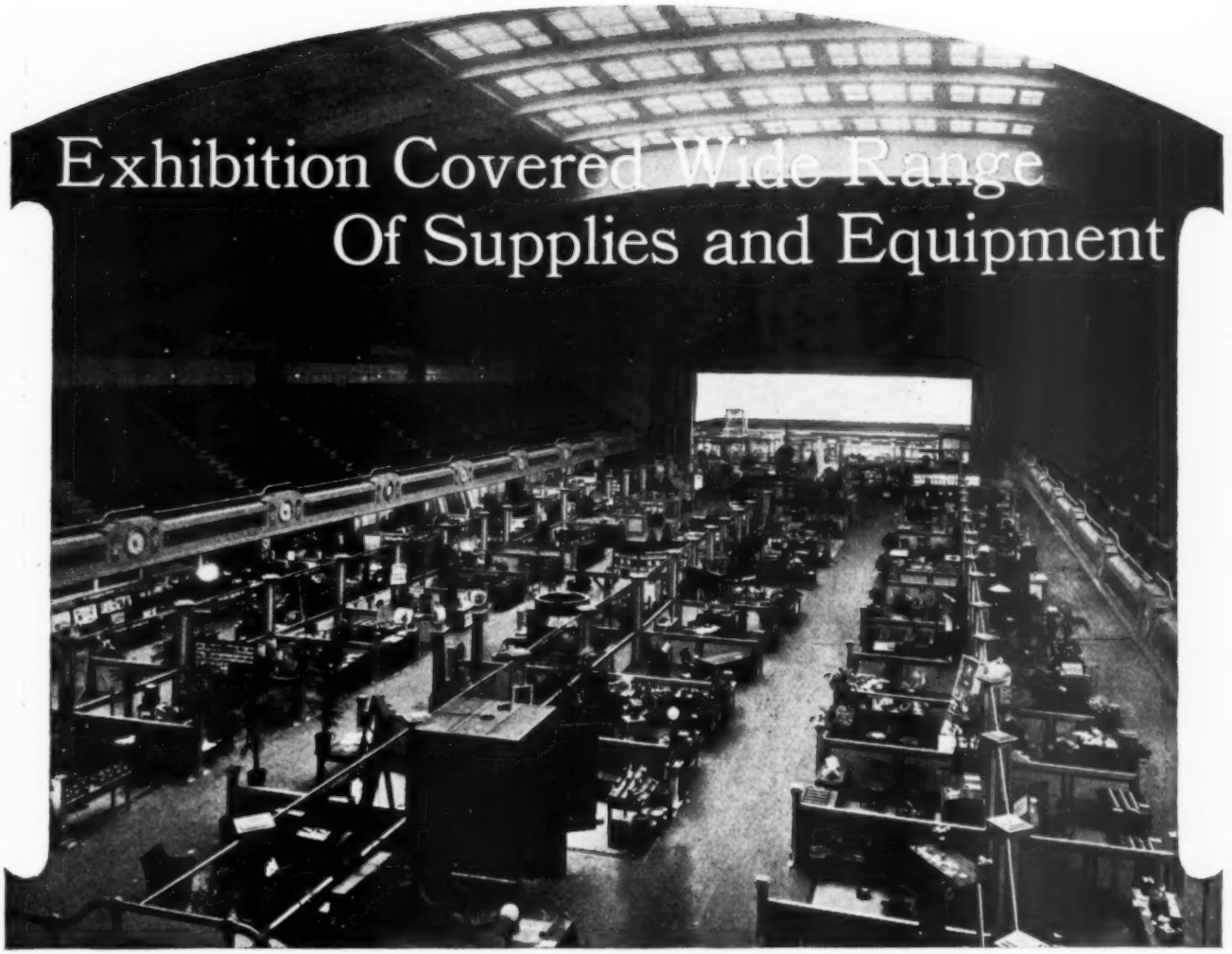
After carefully considering the relative merits of the various devices submitted in competition for the Obermayer award, the committee appointed by Pres. C. R. Messinger decided in favor of a method for making 12-inch, chilled, mine-car wheels developed by H. A. Mackie and Charles Parsons, Lead, South Dakota. The rig shown eliminates handling chills and reduces the amount of sand and labor required. Briefly it may be stated that the chills are provided with trunnions which swing in cast-iron cradles attached to a pair of I-beams and these in turn are mounted on a suitable cast iron frame. The frame and I-beams are located on the floor in such a manner that the upper surface of the cope is about 30 inches above the floor level. In other words, the molds are arranged at a convenient height for pouring. The chill projects beyond the edge of the wheel rim and is provided with a pair of lugs under which wedges are driven to hold the bottom plate in place.

After the casting is poured the cope is swung back out the way. A bar is inserted in a square opening in one of the trunnions and the chill turned over so that the casting falls out. It is claimed that the only machine work on a rig of this character is involved in drilling holes for the hinge bolts.

Other devices submitted in the competition included a corebox provided with a loose central part designed to form projections on the boss of a small four-way core which otherwise would involve the use of a three part corebox. Suitable pins insured correct location of the various pieces. It was the product of Higgins and Landgraf of the Liberty Foundries Co., Rockford, Ill. An improved type of flask guide and pin was submitted by Fred Ward and E. M. Kipps, W. A. Kipps Jobbing Foundry, Bronson, Mich. R. R. Clarke, General Electric Co., Erie, Pa., presented a pattern and cover.

J. Bibby, Anthes Foundry, Toronto, submitted a method for making stripping plates for intricate patterns. For illustration he chose a small helical gear wheel. The mold for the stripping plate is made and then the gear is placed in the center where the aluminum or white metal is poured around it. After the metal has set the plate is removed from the pattern and any necessary finishing is done, after which it is placed in production.

# Exhibition Covered Wide Range Of Supplies and Equipment



VISITORS to previous conventions of the American Foundrymen's association could not fail to notice at the recent Cleveland convention how keenly foundrymen were interested in molding machinery, sand handling equipment, and conveying machinery Practically all this equipment, in various forms was shown at previous exhibitions but likely nearly all developments along the line of industrial progress, men who are due to benefit, did not seriously consider their adoption until forced to do so. The foundry industry is passing through a changing period apprentices no longer are learning the molder's trade, skilled molders are becoming scarcer with every succeeding year, the industry is expanding and keeping pace with the growth of the country, immigrants no longer pour in a constant stream into the industrial hopper.

Manufacturers of foundry equipment both through inclination and necessity anticipate the needs of the industry and the probable trend of the times and develop equipment accordingly. The life of a pioneer in any line is proverbially difficult and usually a considerable period of time elapses before new ideas are absorbed in any given field. In the present instance through a combination of circumstances as outlined in the preceding paragraph foundrymen as a whole are displaying interest in features which ordinarily would not attract attention until a much later period.

Manufacturers of foundry and metal working equipment and supplies are confident that 1923 will be a banner year in the casting industry. Vision of future needs, enterprises in planning for them and preparedness in fulfilling them were reflected on all sides at the foundry show which was held in conjunction with the twenty-seventh annual meeting of the American Foundrymen's Association at Cleveland.

As the visitor surveyed the mass of equipment crowded into every possible square foot of space on both floors and on the stage of the auditorium, he could not help but wonder how extensive the show would have been if the number of exhibitors and allotments of space had not been limited by the area available. The floor space occupied, exceeded that of any previous exhibition with the exception of the available space at Columbus in 1920 and at Rochester in 1922.

In analyzing the display of machines, tools, supplies and accessories, representing the products of more than 200 manufacturers, it is significant that a great many of them were directly or indirectly involved in the problem of material handling. It has been estimated that nearly 16 tons of material must be handled in the average foundry to produce one ton of castings. If the number of times each item of material is handled is taken into consideration the total number of tons handled rises to the rather surprising figure of over 100. That foundrymen are beginning to realize the importance of the handling problem, was reflected in the unusual number of exhibits of crane, tramrail systems, hoists, conveyors, handling equipment, lift trucks, tractors and trailers, charging equipment, etc. Inasmuch as the majority of this equipment was shown in actual operation, the exhibition of this kind

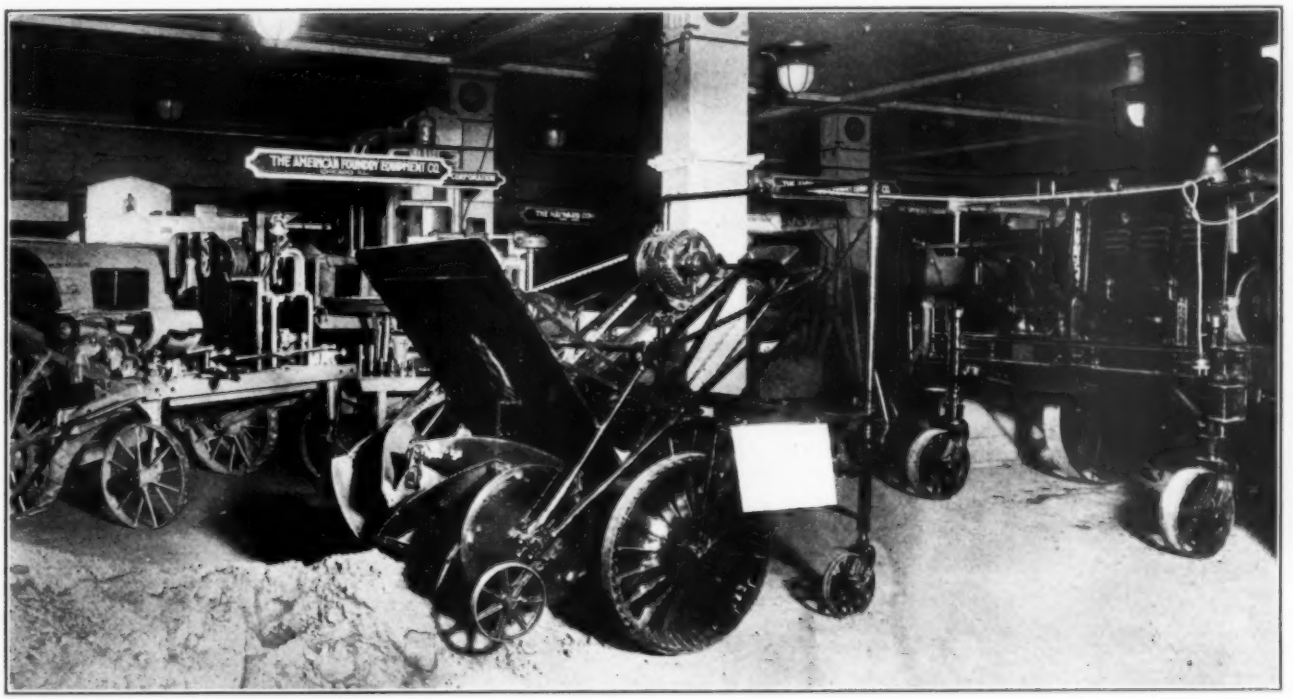
MOLDING MACHINES WERE SHOWN UNDER ACTUAL WORKING CONDITIONS—THIS MACHINE DUPLICATES

PATTERNS AND COREBOXES IN WOOD OR METAL—PNEUMATIC TOOLS WERE DISPLAYED IN ALMOST ENDLESS VARIETY

of equipment attracted most unusual attention.

In the display of molding machines and molding equipment there seemed to be a trend towards specialization. In several cases rather elaborate rigs for special equipment were demonstrated. This also was true in the case of flasks and sand handling equipment. However, refinements in this type of equipment, rather than new designs, marked the majority of exhibits.

The popularity of more efficient methods of preparing molding sand was never more strongly emphasized than at this exhibition. The sand cutters shown by several companies reflected a greated degree of refinement than any of the machines exhibited several years ago. Sand blast equipment was much in evidence in the exhibition hall in the basement of the auditorium. The number of improvements to this type of equipment were embodied in a number of the displays and a number of models of unusual size were shown.




SAND CUTTING MACHINES OF VARIOUS TYPES AND SIZES CONTINUALLY WERE IN OPERATION ON ACTUAL SAND PILES. THE 1923 MODEL SHOWS MANY REFINEMENTS AND IMPROVEMENTS OVER THE ORIGINAL

While the number of machines falling within the strict classification of machine tools was comparatively few, there were a noticeable number of grinding machines, metal cutting saws, pattern making tools, a mechanical die cutter and a wide variety of all kinds of electrical and pneumatic portable tools.

As usual, a great number of manufacturers and dealers of equipment difficult to display in a striking manner were represented. Among these were manufacturers of all kinds of foundry sand, core compounds, metals, pig iron and coke, coal, fluorspar, etc. The display of melting equipment seemed to be less in evidence this year than heretofore, but the exhibition of pyrometers and other equipment used in temperature control indicated that foundrymen are gaining a greater appreciation of the importance of close supervision.

Examples of molding machines shown by the various manufacturers showed no practical difference from those shown at preceding conventions. In a few instances refinements and improvements had been incorporated either in the design or in method of application and in all instances the machines were in charge of experienced operators and kept in motion for the benefit of the spectators. In addition to pattern draw and combination squeeze and stripping plate machines, the Berkshire Mfg. Co., Cleveland had an extensive display of aluminum snap flasks, vibrators and flask fittings.

### Machines Demonstrated

An interesting demonstration of multiple molding attracted considerable attention in the booth of the Grimes Molding Machine Co., Detroit. John A. Rathbone, the inventor of the process had suitable equipment attached to one of the Grimes rollover machines and a demonstration constantly was in progress. A gate of castings made by the process was presented in evidence of the efficacy of the method over the ordinary process of making an individual cope and drag for each mold. The objection sometimes advanced that the castings in the lower molds made in this manner will swell out of shape due to the pressure of the metal, did not seem to be sustained in the present instance. Attention was directed to the fact and a pair of calipers was employed to prove that the castings were uniform in size irrespective of whether they occupied the top or the bottom of the completed stack of molds.

A perfect working model of a rollover jar machine, taking a flask about 10 inches square was employed by the Herman Pneumatic Machine Co., Pittsburgh to demonstrate the ease and particularly the accuracy with which the machine functions. The demonstrator in charge, rolled the pattern and plate back to the ramming position after the mold was lowered away, then elevated the pattern again and once more raised the mold until the pattern was bedded in place. The half split pattern was provided with flanges and pockets at each end and yet when it was once more lowered away, the surface of the sand was in perfect condition, indicating the extreme accuracy with which the table is centered over the pattern draw plunger.

Something new in the method of applying vibrators was demonstrated by the Malleable Iron Fittings Co.,

Branford, Conn. Many foundries charge iron and steel shavings and chips by packing them in containers, usually sections of stove pipe or tin cans of any description. Iron chips pack fairly well but it always has been a problem to pack long curly steel chips solidly in the cans. In the present method, the container is placed on a table provided with a vibrator and as the material is poured in at the top the motion induced by the vibrator packs it solidly. It is claimed that the contents of the can may be increased by from 10 to 25 per cent and in addition the material is not in so much danger of oxidizing as if it were packed loosely.

Among the many machines shown by the Osborn Mfg. Co., Cleveland, the greatest amount of attention centered around one with a lifting capacity of 5000 pounds operated electrically throughout. The machine is of the direct draw, rollover jolt type and illustrates the latest development in a field in which the company has specialized for several years. A flash filling machine also was shown to demonstrate how easily this feature might be adapted to a miscellaneous class of castings.

The advantage of employing a shakeout bail instead of the usual sledge hammer was illustrated in the booth occupied by the Truscon Steel Co., Youngstown. The Stoney Foundry Engineering & Equipment Co., Cleveland manufacturer of the bail invited foundrymen to the plant of the Ferro Machine & Foundry Co., where the bail could be seen under actual foundry operating conditions.

New equipment shown included a Lowe Electric sand riddle with guard separating riddled sand from screenings, by E. J. Woodison Co., Detroit, specially designed trucks by W. J. Teetor Co., Cadillac, Mich., a new aluminium mold jacket by the Springfield Aluminum Plate and Castings Co., Springfield, O., and a squeeze jolt machine with new type valve by Johnston and Jennings Co., Cleveland. The Hardinge Co., New York, have new abrasive material; Beardsley-Piper Co., Chicago, a portable sand slinger ramming molds, and the Federal Malleable Co., West Allis, Wis., a jolt squeeze stripper, air operated throughout.

### New Equipment Noted

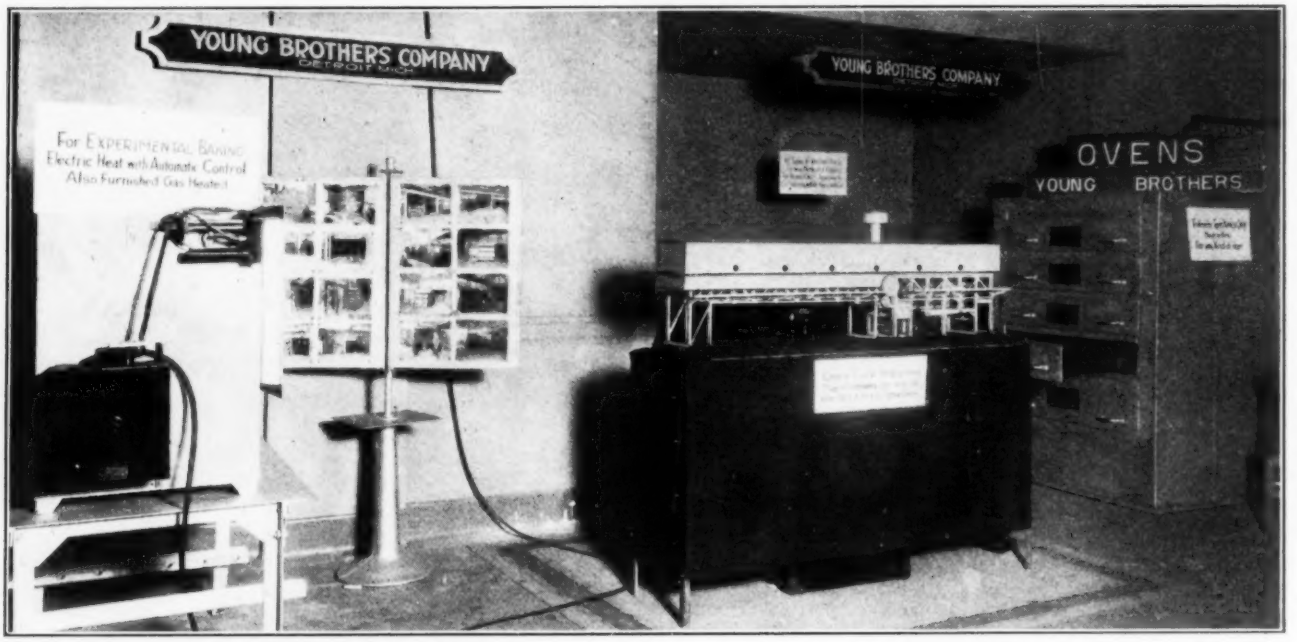
Among the new equipment which was shown for the first time at the convention were a sand cutter made by H. L. Wadsworth, Cleveland, and a car mover of the Safety Equipment Service Co., Cleveland. The new model cutter was shown together with the regular large 10 foot model. In addition to the new car mover the Safety Equipment Service Co., brought out an improved sand blast and dust hood with adjustable head band. An automatic core box filler capable of filling two boxes at a time just had been placed on the market and was being shown for the first time by Wm. Demmler & Bros., Kewanee, Ill. They were demonstrating also their other types of automatic core fillers.

In illustrating the new features of material designed for plant construction and maintenance the David Lupton's Sons Co., Philadelphia, exhibited for the first time a continuous top hung sash having no lower projection, thereby eliminating corrosion; The Skybryte Co., Cleveland, in its first American Foundrymen's Association exhibit demonstrated the application of its prepared powder and solution to the cleaning of factory and foundry windows encrusted with dirt and grime. The Arex Co., Chicago, also in its first American Foundrymen's Association exhibit installed for demonstarting purposes, a model of its smoke exhauster.

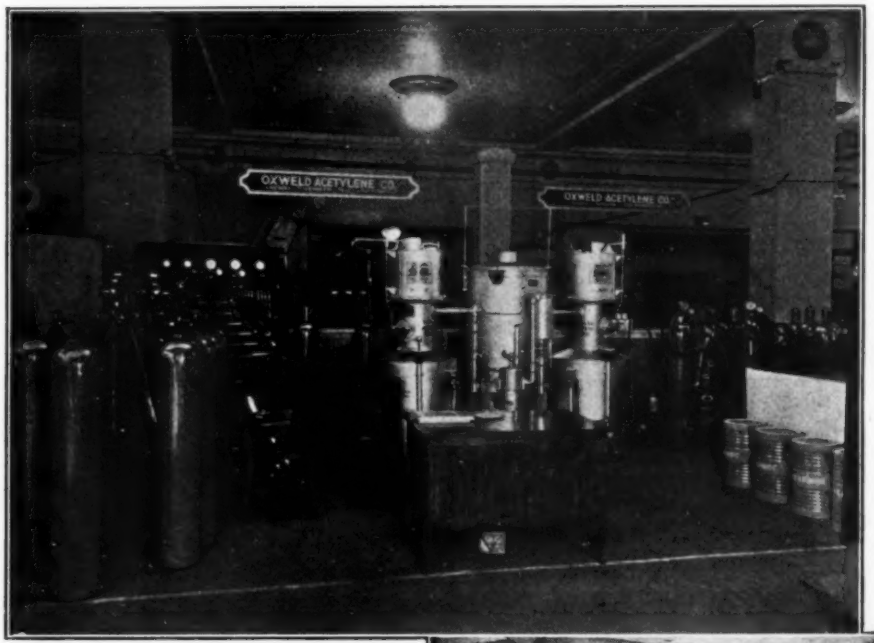
Bethlehem Steel Co., Bethlehem, Pa., illustrated by a group of photographs the mining and reduction of ores from Cuban mines and also displayed nodules and ore from its mines. Truscon Steel Co., Youngstown, among its lines of foundry equipment which were shown, had a flask from which had been cast 3750 automobile engine cylinders.

A huge lump of coal was part of the material shown by S. Obermayer Co., Chicago. A guessing contest was held with two prizes as awards for the closest estimate of the weight of the coal, a specimen from the mines of the Westmoreland Coal Co.

To illustrate fully the methods by which lumber is made, the Dock & Mill Co., North Tonawanda, N. Y., had an exhibition, a 12 foot log, 3 feet in diameter with the various cuttings marked on the ends of the log to-




CORE OVEN MANUFACTURERS SHOWED THE TREND OF THE TIMES TOWARD THE UTILIZATION OF ELECTRIC CURRENT FOR HEAT—MANY ACTUAL INSTALLATIONS ON FULL SIZE SCALE WERE OBSERVED

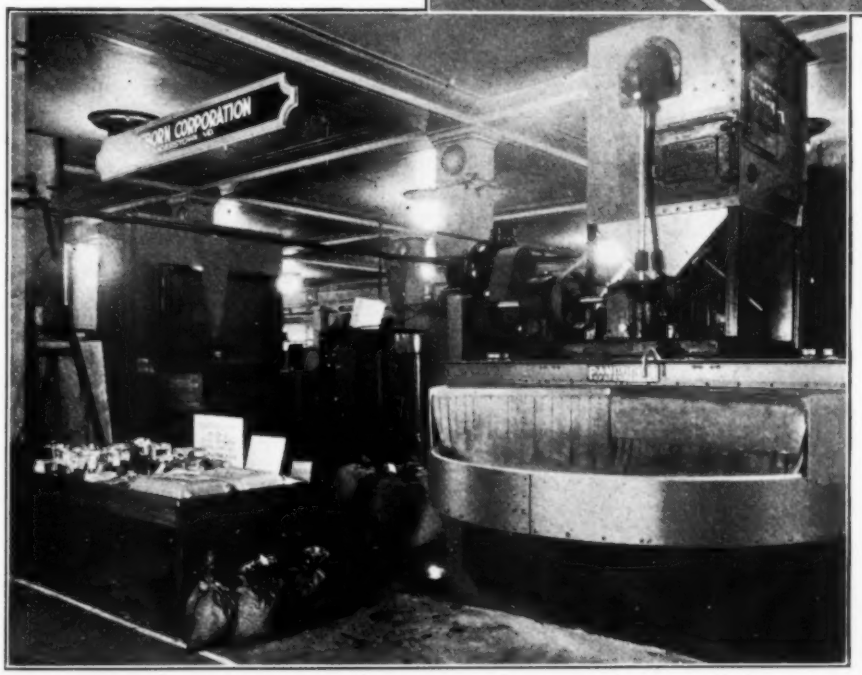



PRACTICALLY EVERY SIZE, TYPE AND STYLE OF WELDING APPARATUS WAS SHOWN BY SEVERAL COMPANIES

gether with pieces of soft white pine cut from a similar log to the one on display. Caster Bloxonend Flooring Co., Cleveland, displayed three types of flooring which it makes and the Thomas E. Coale Lumber Co., Philadelphia, showed pattern flask woods.

Over $100 worth of gold bar, silver bar and granulated silver featured the booth of the Balbach Metals Corp., New York. A variety of castings from antimony and lead were arranged to show the scope of work done in casting the metal. Ingot brass and bronze with rough and finished products made from similar ingots comprised a part of the exhibit of the Michigan Smelting & Refining Co., Detroit. S. Birkenstein & Sons, Inc., Chicago, showed virgin and refined nonferrous metals and the British Aluminum Co., Ltd., New York, exhibited aluminum castings and bars. Aluminum castings of a large variety of commodities from adding machine cases to vacuum cleaners, etc were on display in the booth of the Doehler Die Casting Co., Brooklyn, N. Y. White & Bros., Inc., Philadelphia, showed samples of castings of copper together with ingots of manganese bronze and white metals. Seven samples of shoes for foundry service were shown by the Safety First Shoe Co., Boston. Waldo, Egbert & McClain, Buffalo, had in its booth a variety of coke and pig iron samples. The Spencer Turbine Co., Hartford,

THE EXHIBITS RANGED FROM CORE COMPOUNDS TO MELTING FURNACES

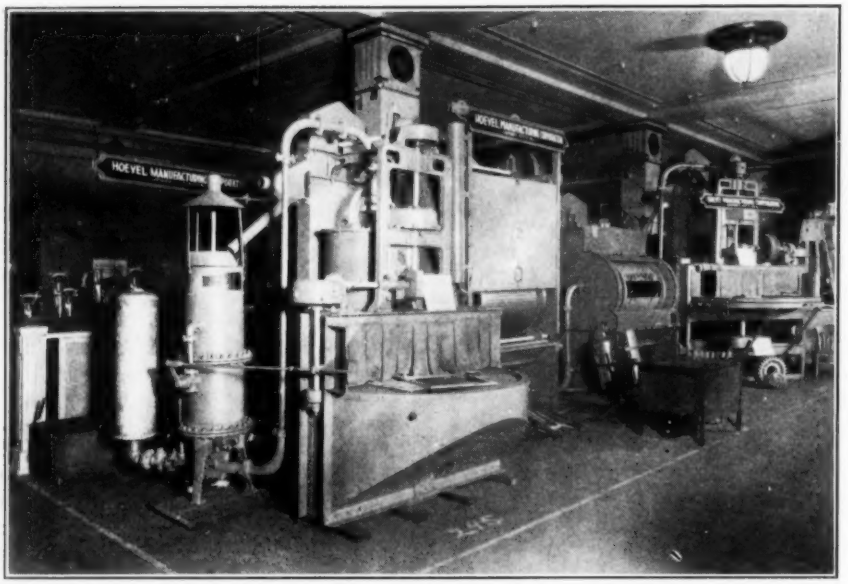


THE ABRASIVE AND THE MACHINE USING IT WERE SHOWN

Conn. demonstrated the use of the turbines which it manufactures. P. H. & F. M. Roots Co., Connersville, Ind., had in operation a working model of a rotary blower.

Air Reduction Sales Co., New York, demonstrated the use of the oxygraph and comagraph together with other welding apparatus. The General Electric Co., showed a semiautomatic ore welding equipment. Some other companies that displayed welding apparatus and equipment were Electric Welding Machine Co., Detroit, Super Arc Welding Machine, Detroit, and Oxweld Acetylene Co., Chicago.

The extensive display by many manufacturers of trucks, tractors, monorail installations, etc., indicated in a striking manner the trend of the times in foundry practice toward im-



EVERY TYPE OF SANDBLAST WAS REPRESENTED

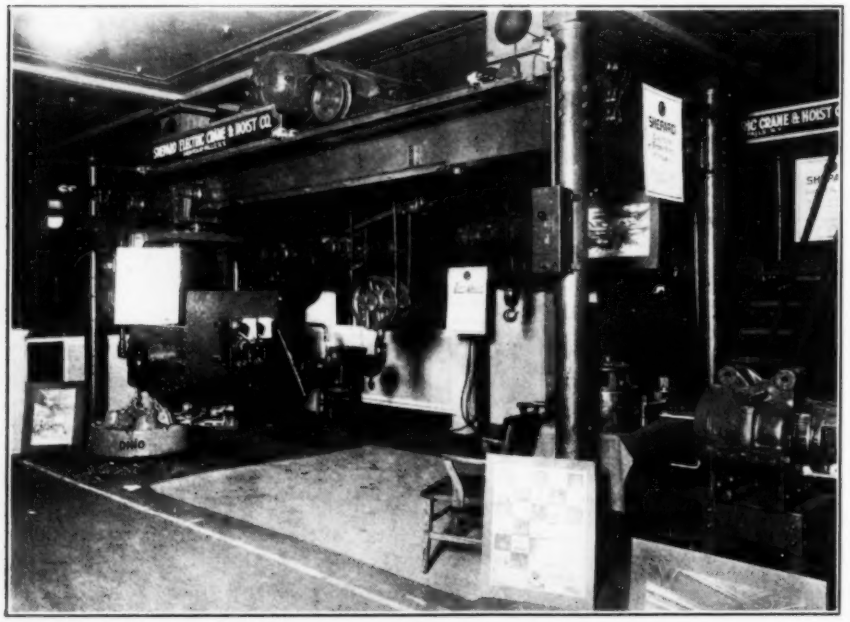
proved and more extensive mechanical methods for handling and conveying materials. Practically every prominent manufacturer of this line of goods was represented by typical installations.

Interesting exhibits illustrating in some instances the method of manufacture and in others the application of product were shown by manufacturers of miscellaneous foundry supplies; core binders, coal dust, cupola and ladle lining, S. Obermayer, Chicago, had two low brick walls illustrating the application of a plastic material for repairing burned furnace walls.

Several manufacturers of nonferrous melting furnaces directed attention to them by photographs and literature while others employed gates of casting poured from metal melted in the furnaces to illustrate the fluidity and other desirable characteristics of the metal. The display featured practically every type of commercial furnace with the exception of the old fashioned pit crucible furnace operating under natural draft.

Core oven makers showed regular brick ovens and also models of various types including a continuous oven in which the cores are loaded green at one end and taken out dried at the other end. Some of the ovens were designed to burn practically any kind of material fuel, and others are equipped to utilize electric current.

One of the features of the show was a talking cupola at the booth of the Quigley Furnace Specialties Co., New York. This company described cement and refractories used in the cupola and pouring spout by means of an amplifying horn concealed in the blast pipe. The effect was that of a radio receiver. An operating model of a pulverized coal system for a malleable foundry was the display of the Bonnot Co., Canton, O. Robert Gordon, Inc., Chicago, showed a quarter size working model of a hot blast heater for industrial establishments.



ELECTRIC CRANES WERE SHOWN EQUIPPED EITHER WITH HOOKS OR MAGNETS FOR HANDLING ANY KIND OF MATERIAL

Among the exhibitors of temperature recording apparatus were Leeds & Northrup Co., Philadelphia, which showed a temperature recorder for malleable annealing ovens, an optical pyrometer for melting furnaces, a wall type potentiometer recorder and an electric furnace for checking thermocouples. Taylor Instrument Co's., Rochester, N. Y., displayed recording thermometers for core ovens, molten metal indicating thermometers, pyrometers, and a temperature control for core ovens. Pyrometers of both the radiation and thermoelectric types, also pressure and volume gages were exhibited by the Bacharach Industrial Instrument Co., Pittsburgh.

Tools and equipment of the same general character were confined altogether to those employed directly in the various departments of the foundry or pattern shop. Probably the most interesting example was a machine made by the Keller Mechanical Engineering Corp., Brooklyn, N. Y., for duplicating an intricate pattern either in wood or metal. A leader following over the pattern or corebox to be reproduced, while a cutting tool generated the desired contours on the second pattern. The machine is adapted to making patterns and coreboxes from models made from any kind of material and also may be employed for duplicating existing patterns or coreboxes.

Two manufactures of wood working tools had operators present demonstrating band saws, lathes and planers.

Complete sandblast installations of various types and made by all the principal manufacturers of this and allied equipment were presented in sufficient volume and variety to indicate the importance of this side of foundry practice.

Elaborate displays of pneumatic tools including grinders, hammers, rammers, chippers, couplings, hoists, drills, etc., were made by several manufacturers, some in operation and others merely on display. A complete electric sub-station for foundry use was installed on the main floor.

# President Summarizes Work

## Accomplishments of the Association Have International Influence Upon the Advancement of the Foundry Industry—Favors Standardization of Testing Methods

BY C. R. MESSINGER

ALL associations desire to increase their activities with the result that often too many things are attempted and too few well done. Possibly we have erred in this respect, but if so our mistakes have been relatively few as each year our technical sessions and work throughout the year have been of a higher order than of that preceding. It is a fact, however, that the volume of our technical work has increased more rapidly than has our ability to handle it. Few technical associations have exhibits in connection with their annual meetings, and no other attempts anything that compares in magnitude with ours. The financial arrangements and the work of preparing and conducting the exhibition are so great that too large a proportion of Mr. Hoyt's time is taken from the truly technical work of the association. It has been suggested that the association employ a high-grade technical man whose whole time would be devoted to the association.

### Technical Secretary Needed

I am heartily in accord with this suggestion. We are the body that represents the technical side of the foundry world, and when we consider the magnitude of this industry it should stimulate us to greater accomplishments. If we stop and think of the improvements in foundry methods during the last fifteen years, it will help us to visualize the possibilities for the future. The basis for our development is the work of the chemist, the metallurgist, and the engineer, and the association must never neglect an opportunity to carry on research work of the highest order. In the past the members of the industry and those supplying it have been generous in their support of the association and this support will increase. I hope the association can without delay adopt the suggestion that we employ a technical secretary under whose direction will come all activities of a technical nature.

This year a Committee on Foreign Relations was organized with H. Cole Estep as chairman. Through the work of this committee and Mr. Estep, who is located in London, much has been done to keep in touch with the work of the associations similar to ours in England, France and Belgium.

The establishing of more intimate relation with the technical associations of Europe is of national significance and nothing but good can result from work along these lines. If the technical associations of all countries will co-operate in a way that seems possible for us, perhaps it will help to eliminate some of the international misunderstanding of which we hear so much. Our work with the societies representing the foundry industry in Europe is a step forward and it is within the range of possibility that a great International convention can be held in conjunction with our 1926 meeting, which will celebrate the 150th anniversary of the Declaration of Independence.

At the Columbus meeting the association was the recipient of some generous donations from members. The proceeds of these donations are to be devoted to awards for work of merit in the industry. The handling of such large sums for future generations under conditions very different from those of the present, places a new responsibility on the association. Your directors have decided that this can best be done by a self-perpetuating board, and this board is being guided by the experience of other associations with funds of this kind. At present a deed of gift acceptable to the donors and to the association is being drafted and it is hoped that the funds can be properly safeguarded and yet give those who administer them in years to come the power to meet conditions as they find them and make awards which will meet the ideas of the very generous contributors. It is regrettable that it is impossible to make but one award this year, that is the Obermayer, but this failure cannot be attributed to the present board of awards. The situation is now clarified so that a satisfactory conclusion should be reached promptly.

The molding sand research has been referred to before. The $2500 had been contributed by the Pangborn Corp., Hagerstown, Md., and $1000 by the National Engineering Co., Chicago to be used as the directors might designate for some useful advancement of the foundry industry. The directors', after careful thought, decided to utilize the funds in studying molding sands, which investigation was accordingly organized in December, 1921. All will remember the very great interest that attended the first reports of this committee at the Rochester convention. Since that time the committee has done a tremendous amount of work, largely along the line of developing satisfactory methods of testing sand. Such methods have been very seriously needed by the foundry industry which has been without any suitable means of comparison and selection.

### Reports Sand Results

It now appears that methods have been finally developed which have been found sufficiently satisfactory to justify definite recommendation by the joint committee at this convention. The methods recommended as tentative for one year's trial include the three which are regarded by the joint committee as essential. They will determine bonding strength or cohesiveness, permeability and fineness; and a method is recommended by the committee for the sampling of molding sands. Your president feels that the announcement regarding tests as well as the progress made in arranging for geological surveys and reclamation will be of great interest to foundrymen.

Attention can appropriately be called to the fact that this joint committee is of remarkable character, consisting as it does of 48 men officially representing not only the American Foundrymen's association but the National Research council, the American Society for Testing Materials, the U. S. bureau of standards, the U. S. bureau of mines, the Canadian department of mines and other organizations. The complete personnel of the joint committee includes gray iron foundrymen, steel foundrymen, malleable foundrymen, nonferrous foundrymen, sand producers, metallurgists, engineers, chemists, geologists, physicists, ceramists, refractory experts, and in fact all who have theoretical or practical information of value in the consideration of so large a problem.

It is gratifying to state that these

Abstracted from the annual address of the retiring president, C. R. Messinger, at the Cleveland convention, April 30 to May 3.

committees have been materially assisted by the work of many other investigators who have co-operated to splendid effect. Such assistance has come in marked degree from Cornell university and from the University of Illinois. The bureau of standards has been of vast help through membership of individuals like Dr. G. K. Burgess and his assistants in the metallurgical division of the bureau. Dr. H. Ries, head of the department of geology at Cornell university, has, as chairman of the subcommittee on geological surveys, been of very great assistance in his work. These institutions and individuals are mentioned particularly because of the assistance received from them despite the fact that they are not directly related to the foundry industry.

It will be plain from the foregoing that the committee's recommendations are entitled to very hearty endorsement by the foundry industry, which should exhibit keen appreciation of the service that is being rendered by these gentlemen without compensation. The chairman of the joint committee informs me of having just recently received at a most opportune time an unsolicited contribution of $1000 from the American Foundry Equipment Co., New York to be applied to this work. More funds are needed now to permit the desired prosecution of certain phases of the work that have necessarily been delayed until satisfactory test methods could be developed. It is confidently believed that there will be no difficulty in securing needed sums to continue this investigation, which has marked a distinct step forward in scientific achievement by our association.

### Local Groups Favored

With the growth of the industry in certain centers, local foundrymen's associations are being organized, and the fact that foundrymen are getting together locally is an indication that closer relationship is needed between our association and its individual members. Any movement which draws foundrymen together cannot be looked upon with disfavor by us and yet anyone with vision, no matter how great his interests may be in a local organization, cannot but see the value of a strong national association. I am confident that a plan of local sections can be worked out that will benefit both the American Foundrymen's association and the local organization. A definite plan has not as yet been crystallized but it has been suggested that sections could be organized by us and that membership in the American Foundrymen's association would constitute membership in the local. Funds could be allotted to locals according to their activity and the number of members. The employment of a technical secretary as suggested would not only put us in position to help organize these locals, but we could through the year furnish technical information that would be helpful, and interest in the American Foundrymen's association would be stimulated during the year. I am sure that if we do our work well through locals from one annual meeting to another, there will be more interest and larger attendance rather than smaller at the annual meeting. Our membership would increase by this plan and from this increase, funds would be available with which to help locals.

### Labor Scarcity Grows

The scarcity of foundry workers presents a serious problem and statistics recently published by the National Industrial Conference board are of particular interest to us. Analysis of the immigration statistics for the first complete fiscal year of operation under the present law, shows that the number of immigrant aliens admitted was approximately 309,556, and the number leaving was approximately 198,712, making the net increase in population by immigration 110,844. This figure is less than one-fifth of the gain in the year preceding the present law becoming effective. This figure is even more significant when it is considered that of 110,844 increase 104,326 were women and children and only 6518 men. Considering both immigrant and nonimmigrant aliens admitted and departed, the first fiscal year's operation of the law shows a net loss of 11,687 males to the country. On the other hand, in September, 1922, there were 6181 foundries in the United States, which is a gain of 217 in the past two years.

A foundry's proportional expenditure for labor compared to its output is much higher than that of the average manufacturing plant. This means that many men are employed. With the tendency toward unrest and dissatisfaction among our people, we, if for no other reason than our own welfare, are obliged to do our part and see that working conditions in our foundries are what we know they should be. Under anything like normal business conditions we always have a labor shortage, and this condition will grow worse rather than better until the present law is amended. The American Foundrymen's association should stimulate invention and encourage the use of labor saving machinery. In the past we have played our part in the great safety movement and in the future we must lend our aid in removing as far as possible the heavy and frequently too burdensome jobs. This phase of the foundry will have even more prominence in the next decade than it has in the past. If this is to be so it is well for us to recognize it at an early date, and so shape our policy that we may offer the greatest help to our members in meeting their every day operating problems.

Standardization of pattern equipment opens another field of endeavor. The majority of our members are connected with so-called jobbing shops and know too well the difficulty of getting pattern equipment that can be used in connection with molding machines. It is mediaeval to use hand labor when it can be done by machine, thus releasing men for other work, and yet it is very often necessary because the purchaser of castings will not take the necessary expenditure to obtain proper patterns and equipment. We sometimes forget that foundrymen and manufacturers of equipment have many different standards and that buyers of castings are often put to needless expense when changing patterns from one shop to another.

The increase in membership in the past has been gratifying, but we suffered, as did most organizations of a similar character, during the period of retrenchment. Your officers and directors have many plans which are dependent upon a large membership and the resulting income. All thoughts for the future are based upon helping our industry and I believe the twenty-seven years of service rendered by the A. F. A. puts an obligation of membership on any man who expects to make his life work the foundry. A survey of attendance shows that many attend our annual meetings who are prominent in the industry but are not members. All are welcome, but we the members should realize that our association has a record of accomplishment and much to be proud of, and if this thought is broadcasted many of the thoughtless ones will realize that they owe us their support. We should show a continued increase in membership and interest, and should accomplish more in the future than in the past.

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## Displays Marksmanship

W. D. Frazier, the Berkshire Mfg. Co., and Harry Bouten, Standard Sand & Machine Co., both of Cleveland, the champion rifle shots in the foundry world are now open to challenge. Mrs. George L. Grimes of the Grimes Molding Machine Co., Detroit, almost took the honors away from them April 29 at the indoor rifle range at the home of Mr. Frazier. Mrs. Grimes made a remarkable record, hitting the bull's eye almost every time. The range is one of the most interesting private rifle ranges in the country extending under ground from the basement of the house to the garage, a distance of 25 yards.

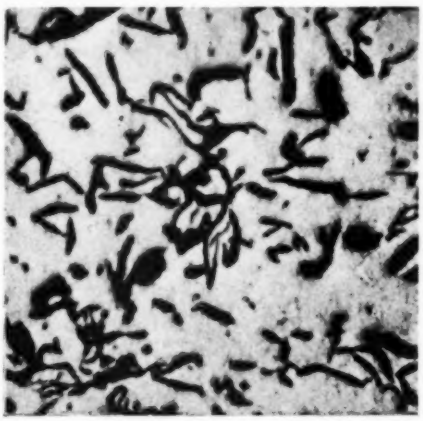
# Graphite Controls Gray Iron

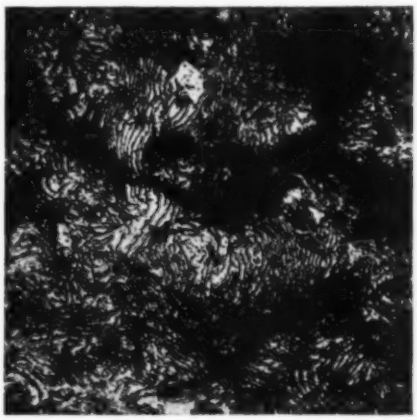
## Size of Flakes Influences Quality—High Carbon Irons Sometimes Stronger Than Iron of Lower Carbon—Need Shown of Standard Testing Methods and Research on Fundamental Principles

BY J. W. BOLTON

ON READING the foundry papers of today, we note the constant recurrence of such words as scientific, efficient, production, research, metallography and analysis. Some twenty-five years ago these words were little used in foundry circles. Their use today is an indication of new conditions and new factors in the iron industry. Let us consider whether these new conditions, this new era, in the foundry game really stands for better things.

Business men of today understand that ultimate success depends on giving the best all-round service to the customer. The single price, guaranteed merchandise, and truthful advertising are evidences of this. It is not because it is good morals, but because it is good business that business men look after the customer's interests. The average foundryman realizes this. It used to be, and in many cases still is, that castings were sold on price and weight alone. Cutting prices proved disasterous to many, and it is safe to say that most foundries pay closer attention to their manufacturing costs then they formerly did. The practice of selling castings on a weight basis alone is wrong for two reasons. First, different classes of castings vary in cost of production. Second, the heavier casting often gives the poorest service. The true basis for selling castings is service to the customer. This service may be in the form of better design, of higher quality materials, or of lower cost per year of use. A question of great interest to us today is the production of higher quality materials. The graphite of gray iron is one of the major factors governing quality. Therefore, study of the various phases of graphitization should help us in producing better castings. The foundryman is after practical results. Theory is all right in its place, but theory and research are only means to an end. We must not let the tail wag the dog. Nothing ever will take the place of good common sense—and true research is common sense. We say that this new era stands for better things because it means more profits to the progressive foundryman and better service to the customer.





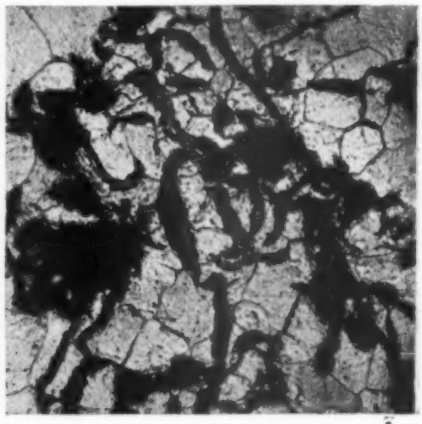


FIG. 1—BLACK INDICATES GRAPHITE FLAKES UNETCHED—× 100 DIA. FIG. 2—PEARLITIC MATRIX WITH BLACK GRAPHITE FLAKES—ETCHED WITH PICRIC ACID—× 600 DIA. FIG. 3—POLYGONAL GRAINS OF FERRITE WITH GRAPHITE SHOWING GRAY AND TEMPER CARBON BLACK—ETCHED WITH PICRIC ACID—× 100 DIA.

### Graphite Influences Quality

The existence of graphite flakes is what makes gray iron a commercial possibility. It if were not for graphitization, it would not be possible to produce a good machineable iron in the cupola. Graphite flakes are what help give gray iron many of its unique engineering properties, such as rigidity and ready machinability. While graphite imparts desirable properties, it also gives some undesirable ones. Among these are little resistance to shock, low strength, and open grain. Whether he realizes it or not, the foundryman controls the quality of his castings largely by controlling the formation of graphite.

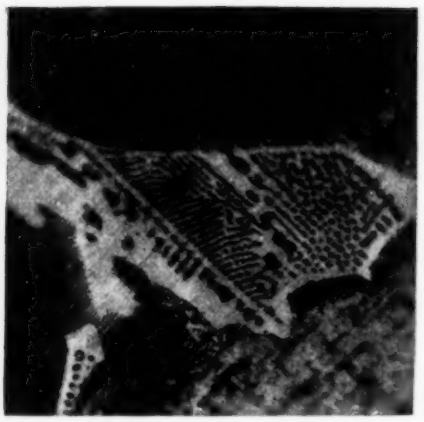
Since the question of graphitization is such an important one, we need to know enough about it to exercise intelligent control. It is the writer's intention to outline as briefly as possible what we know today about the phenomena of graphite formation.

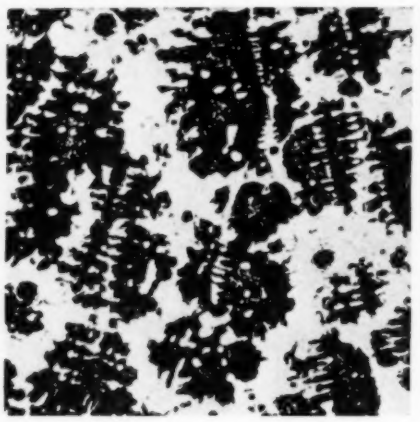
Graphite is found as weak, pencil-like flakes distributed throughout the metal, as shown in Fig. 1. These flakes are largely graphitic carbon enmeshed in a ferrite (pure iron) network, as illustrated by Fig. 9. They also contain some sulphides and occluded gases. This is indicated by Fig. 12.

Besides graphite flakes, gray iron is made up of varying amounts of pearlite, Fig. 2, ferrite, Fig. 3, and steadite, Fig. 4.

The graphite flakes are formed by the breaking down of the combined carbon of the iron during cooling. Some recent work shows that, under certain conditions, the original distribution of combined carbon has an important influence on the formation of graphite, as indicated by Figs. 5, 6, 7, and 9. That is, the first growth and distribution of graphite is determined by the form the combined carbon

Paper presented at the Cleveland convention of the American Foundrymen's association, held April 28 to May 3. The author is chemical engineer, the Niles Tool Works Co., Hamilton, O.





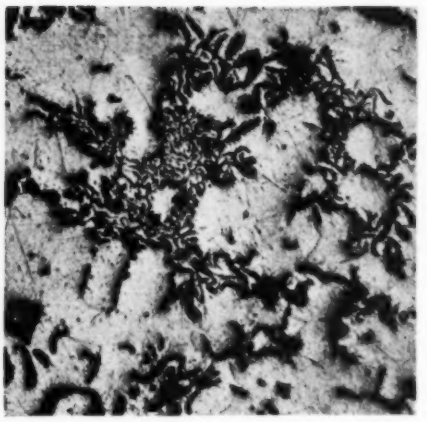


FIG. 4—STEADITE DENTRITE WITH CELLULAR STRUCTURE—ETCHED WITH BROMINE IN AMYL ALCOHOL—× 735 DIA. FIG. 5—GRAPHITE FORM RESEMBLING PRIMA AUSTENITE IN OUTLINE—UNETCHED—× 125 DIA. FIG. 6—GRAPHITE RESEMBLING LEDEBURITE DENTRITES—UNETCHED—× 100 DIA.

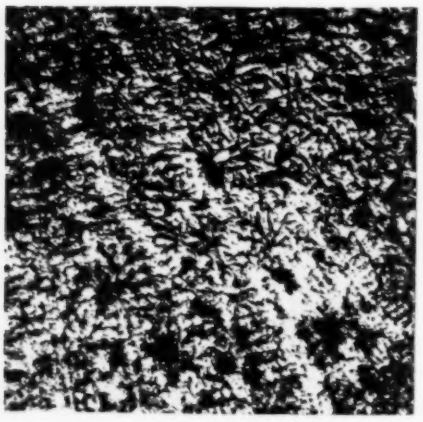
would have taken had the iron been chilled white. This has an important practical bearing on the question of strength, grain, and composition of the iron and will be referred to later.

Graphite influences the physical properties of the metal according to its amount, its size, its distribution, and its shape. The bulk of graphitizations takes place between the final solidification (eutectic) and the formation of pearlite (the eutectoid). This graphitization ordinarily affects only the free combined carbon which is called cementite, and is found as such in irons with over 0.90 or 1.00 per cent combined carbon. In this case the resulting metal looks like that shown in Fig. 2. Unfortunately graphitization does not always cease here but takes up carbon from the pearlite as shown in Fig. 12. This reaction is accompanied by the phenomenon of graphite growth, as distinguished from primary graphitization. The result is large, coarse flakes of graphite surrounded by weak envelopes of ferrite. This conditions causes low strength brittleness, and open grain. As the writer has pointed out in other papers, it is probable that graphitization of commercial irons proceeds below the pearlite transformation range, ceasing only when the rigidity of the metal prevents further migration of carbon.

### Controlling Growth of Flakes

The growth, or size of graphite is influenced by the rate of cooling, the variation in size of the first flakes, and the condition of the metal layers between flakes. Under present conditions, the rate of cooling is governed largely by section size. Where castings are fairly small and have reasonably uniform sections, the effects of cooling can be balanced by regulating the silicon. However, in the heavy machine tool work, with the general run of castings from 5 to 25,000 pounds, and sections from ¼ to 8 inches in depth, supervision is necessary. That we have established an average of 4150 pounds (arbitration test bar) for one of our mixtures, over a long period, and can produce a reasonably close grain iron in heavy sections is evidence of practical accomplishment.

General laws of crystal growth show that growth is accelerated by having crystals of varying size, so that the large grow at the expense of the small. The practical significance of this is that if we have coarse flakes arising from some pre-existing component, say prima austenite, and small flakes from another say ledeburite, we are more likely to have growth than if the whole structure is fine, say of eutectic composition. This explains why, under certain conditions a higher total carbon may produce a stronger iron. If the iron is of eutectic composition, for example, with 3. 75 per cent carbon, the initial graphite will be in small flakes and growth may be hindered at first. On the other hand, the presence of more graphite (its mass acting as an accelerator for growth) and the effect of a greater volume of graphite (if growth is at all complete) may have the opposite effect. The fact is that today we cannot specify a single optimum carbon for all grades of castings. All the factors must be carefully weighed. In some places, in heavy sections low carbon may be best. In small sections it is likely that rather high carbon will give the desired results. If, besides the actual flake structure of the graphite, we consider the variations in melting prac-



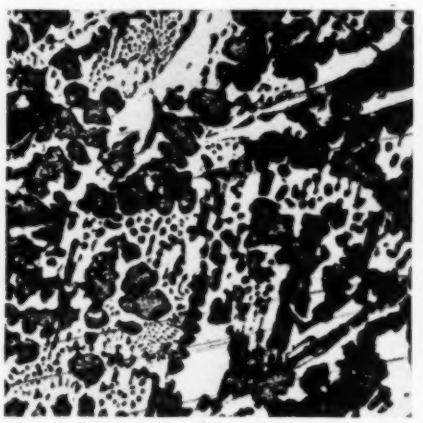


FIG. 7—STRIATED GRAPHITE—UNETCHED—× 50 DIA. FIG. 8—CHILLED IRON SHOWING CEMENTITE (WHITE) AND AUSTENITE—ETCHED WITH PICRIC ACID—× 75 DIA. FIG. 9—GRAPHITE FLAKE SHOWING NETWORK STRUCTURE—× 640 DIA.

tice necessary to produce different carbons, and the possible effects of these changes, we see that the carbon question is indeed a complex one.

Silicon is the element by which the foundryman manipulates his carbons, controlling the ratio of combined to graphitic. The exact mechanism of silicon action is not completely worked out. It behaves much like carbon in the iron crystal, suggesting possible interchangeability. It lowers the amount of carbon required for the eutectic so that for small castings higher silicon and lower carbon should give better results than higher carbon and lower silicon.

To make this paper more interesting to the practical foundryman, questionnaires were sent to a number of leading foundrymen and metallurgists. The questions were designed primarily to find out just how the industry thinks about the carbon-graphite question. The answers show that 95 per cent of the men questioned favor low total carbon for high strength—high deflection irons. To get an iron 4000 pounds transverse test on the arbitration test bar, silicons ranging from 1.10 to 2.35 per cent were advocated. This is quite a range, especially when the majority recommended 3.00 to 3.25 per cent carbon to accompany the same. The majority advocated phosphorus about 0.40 per cent, ranging from 0.30 to 0.60 per cent. Sulphur up to 0.10 was specified. The general opinion was that the manganese should be 0.50 to 0.80 per cent.

The fourth question asked what should be the proper factor for converting transverse to tensile strength. Answers varied from 6.70 to 9.30, a difference of over 25 per cent. It was brought out that quite a number of foundries do not use the arbitration test bar. The writer thinks, as a result of conducting a number of tests on various size and shape bars that it is not accurate to convert tests using the section moduli. We have to use the same bar to get comparsion, and the bar must be 1.25 inch, not 1.40 or 1.10 inch; that is, caliper the bars. We could take a square bar, get a high deflection and strength, then figure it to a round, with considerable advantage to the results. But no one would be fooled except ourselves. Also, the apparatus for measuring deflection should be specified. We want the bend of the bar itself, not the relative movement between the center knife edge and the table. The testing societies should specify how this test should be made.

The majority of those who answered felt that 15 per cent to 20 per cent steel gives the best results. None expressed any decided preference for machine or sand cast pig. A number recognized causes of open grain other than high graphite. In this connection it should be mentioned that an open grain iron with a ground finish will present a better appearance than a close grain iron finished on a lathe or planer. The microscope furnishes the only means (besides fracture) of distinguishing the real grain structure.

All the foregoing data show one thing—there is no short, easy road to success. Foundry metallurgy needs more fundamental research before the road to successful operation can be pointed to with certainty. One part of this needed research is the study of the influences of graphite. We know enough about graphitization to improve a number of types of castings. Much more work is needed before we will know what to do for each particular job.

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The welding shop of the Metal & Thermit Corp., Jersey City, N. J., has been equipped for making welds on light sections with oxyacetylene and electric processes.

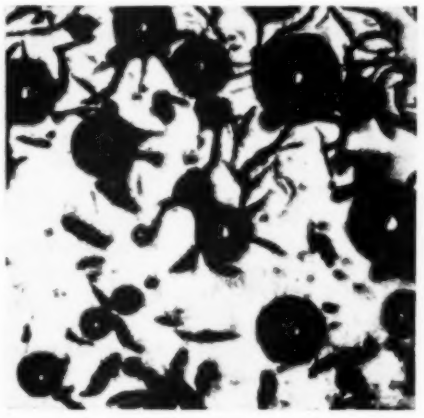
## Industry in Ceylon Found Depressed

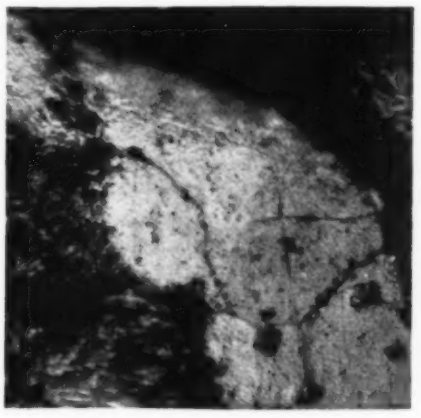
An interesting side light is thrown on the plumbago situation in the leading foreign center of its production by an American observer in an interview reported in the *Ceylon Morning Leader*, Colombo, Ceylon, a copy of which has just been received in this country. Summing up the present predicament of the plumbago industry in Ceylon the *Leader* says:

The local plumbago industry is at present in the trough of depression. It has been so for several months—almost years—past and threatens to continue in this dormant state. America and Germany, potential buyers in the local market, are each now working their own mines thus tending to reduce their requirements of local graphite. What is more disconcerting is that America has recently placed a duty of 20 per cent on all imported graphite so as to give the domestic industry—Alabama graphite—an impetus.

The prosperity of the local industry is so intimately connected with the welfare of the people in general that any suggestions to revive the trade, especially from consumers, should prove of more than ordinary interest. Ceylon is well favored at the present moment in having in the island a representative of one of the oldest buyers of Ceylon plumbago in the American market.

The suggestions therefore which Mr. H. M. Riddle of the Ashbury Graphite mills, Asbury, Warren Co., N. J., throws out for the resuscitation of trade should be of particular interest at the present moment especially as the assistance of government has been invoked. In fact Mr. Riddle is certain that government could and should contribute to place local graphite at a marketable and competitive price in America. This is of the greatest interest coming from a large American importer of graphite.





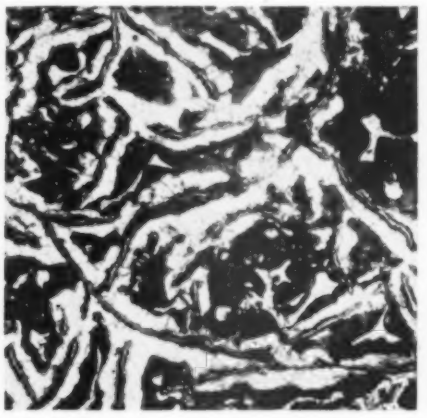


FIG. 10—BUBBLES OF HYDROGEN SULPHIDE SHOWN RISING FROM GRAPHITE FLAKE UNDER ACTION OF DILUTE PHOSPHORIC ACID—× 100 DIA. FIG. 11—ETCHING PITS IN FERRITE—ETCHED WITH PICRIC ACID—× 500 DIA. FIG. 12—LARGE GRAPHITE FLAKES SURROUNDED BY FERRITE

# Casting Art Bronze Tablets

## Careful Attention to Every Detail Essential—Special Flasks Should Be Provided—Melting Practice Important and Temperature of Pouring Requires Care

BY JACOB G. KASJENS

BRONZE tablets represent high grade foundry practice and in their production it is essential that careful attention be given to the flask, sand and every detail of the operation. The cost of making a tablet is so great that one is justified in providing a special flask. For a table 20 x 30 inches, a flask 35 x 40 inches, drag 6 inches and cope 8 inches deep should be used. The flask should be made of 3-inch lumber and the corners should be well braced with angle iron. Three tie rods are required in the cope and a similar number in the drag. Bars are only required in the cope. The guide pins should be accurately fitted and if a crane is available, a trunnion provided on each end of the flask.

Any good sand suitable for fine brass castings may be used for molding tablets. It should be prepared in the following manner the day before it is needed. It is first put through a No. 10 sieve and then about 1 part of core compound is added to 40 parts of sand after which it is put through the No. 10 sieve a second time. The mixture then is wet down to the required degree of dampness and put through a No. 4 riddle. The pile of well mixed sand then is covered with wet bags and allowed to stand until the following morning. The foregoing treatment will yield a strong, mellow mixture which will not require brads to hold the particles of sand between the letters.

A small amount of lycopodium should be dusted on the pattern after it is set in place on the board or matchplate. Any excess of this parting medium should be blown off, otherwise, since it has no affinity for water, it will cause trouble when the mold is sprayed later.

After the drag is placed the facing sand is rammed by gravity to prevent what is technical known as *ramming away*. If a crane and mechanically operated riddle are available, the riddle is hoisted to a height of 10 or 12 feet above the flask. If no crane is present, a step ladder and ordinary riddle may be utilized. About 1 inch of facing sand is sieved on the pattern, then a coarser riddle is employed for the heap sand and finally the remainder of the drag is filled from the same height. The pen of the rammer is used around the edges, but the sand over the pattern is tramped and butted. Before the bottom board is placed in position, the sand is vented freely with a medium size vent wire to within ½-inch of the pattern face.

In ramming the cope a small sprue is placed at each end to serve as a riser and a large sprue is placed near the center of each side for a runner. About ¾-inch thickness of facing sand is sieved on the cope face of the pattern, then the remainder of the cope is filled with heap sand and rammed in the usual manner. It is not necessary to ram to cope by gravity since there is nothing to *ram away*. The cope also is vented freely.

### Pattern Mounted Securely

The pattern is secured by suitable screws so that it will lift with the cope. The lifting is done slowly to break the vacuum under the pattern. The branch gates are cut 5/16-inch wire, ⅜-inch deep and are spaced about 1½ inches apart. Instead of dusting flour on the face of the mold it is sprayed with molasses water and dried. The material is mixed in the proportion of 1 part of molasses to 15 parts of water and is sprayed through an ordinary foundry spray can attached to the compressed air line. The can should be held high and far enough from the mold for the molasses water to reach the face of the mold in the form of a fine mist. The drag of a mold for a 20 x 30-inch tablet will require about two quarts of the mixture and the cope will require one quart.

The face of the mold may be dried satisfactorily with a gas or oil torch, thus avoiding the necessity of placing the entire mold in the oven. If the drying process is allowed to proceed too rapidly there is danger of blistering the face of the mold and burning the small sand pyramids between the letters.

Before the mold is closed, plenty of paste should be smeared on the joint to prevent a runout. After the flask is clamped a rail or I-beam is placed over the center of the cope and clamped at each end to the bottom board. Wood wedges then are inserted between the lower face of the beam and the upper faces of the cope bars to prevent the center of the cope from springing from the force exerted by the molten metal in the mold.

On a tablet of the size mentioned, two crucibles should be used in pouring. Where tablets of a greater area are made, additional crucibles should be employed as a safety factor, otherwise a strained or miss-run casting will result. Any standard art bronze alloy will run well and make a good casting. In some cases it may be necessary to use a special mixture to match the color of bronze work already in place.

Whether the metal is melted in crucibles or open flame furnaces care should be exercised to prevent over heating. It should be covered with charcoal at all times. When the casting is taken from the mold it should be examined for pin holes by filing a number of letters at several points on the border. If the casting is sound, the gates then may be removed and the casting cleaned. In finishing the casting the border surface is filed straight, the letters are faced and then draw-filed to take out the waves. To thoroughly clean the face of the tablet and give the acid dip a chance to act uniformly over the entire surface, the casting should be sand-blasted before an attempt is made to color the surface. Considerable skill and experience are required to bring out the beautiful desired color.

Fine emery paper fitted to a block of wood is employed for the final finish and all polished surfaces are rubbed one way to eliminate waves. Tablets placed inside buildings are lacquered. Tablets destined for the open air age better and more quickly if not lacquered.

Making tablets in a jobbing foundry requires so much extra care and attention that the general character of the work done in such a foundry naturally is influenced favorably. It may be classed as desirable work on this account since it is liable to raise the standard of the work done by the foundry along other lines.

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**The Stroh Castings Co., Chene street, Detroit, has ceased making gray iron casting, and will manufacture aluminum cooking utensils and nonferrous castings exclusively.**

From a paper presented before the Cleveland convention of the American Foundrymen's association April 28-May 3. The author who died April 13 was president Brass Foundry Co., Peoria, Ill.

# How and Why in Brass Founding

By Charles Vickers

## Mixture for Nipples and Ferrules

*We desire an alloy that will be suitable for casting solder nipples and ferrules. We are using borings and add 60 pounds of zinc and one pound of lead, but we have trouble running the castings. We melt with oil, and the metal appears to be hot enough, but still it fails to run properly.*

We note that 60 pounds of zinc are added, but nothing is said regarding the amount of borings used with the zinc. If the borings are yellow brass, the addition of 60 pounds of zinc to a number 100 crucible containing 240 pounds of borings of yellow brass of say 70 per cent copper, 30 per cent zinc, and disregarding the small amount of lead, would produce an alloy containing approximately 56 per cent copper, 44 per cent zinc, less the amount of the latter element burned out, and less the amount of copper, by the percentage of lead. An alloy so high in zinc cannot be cast in sand without great loss as the metal, no matter how hot it may appear, judged by the zinc flare, is sluggish and will not flow, and in order to get it fluid, it is in all cases necessary to add a small amount of aluminum.

If four ounces of aluminum for each hundred pounds of metal in the pot, are added the result will be a fluid alloy, which will easily run the nipples and ferrules; in fact such castings are now most generally made of such an alloy, where before the advent of aluminum in the foundry, they were made of cheap metal such as emery grindings, and sweepings, which could be made hot and fluid, but were much more difficult to run into such castings as ferrules than the high zinc, aluminum fluxed alloys now used. When pouring the metal do not have it so hot it smokes like yellow brass as this is quite unnecessary.

## Monel Metal Mixture

*We would like to obtain the formula for monel metal, as we have an opportunity to make castings of this alloy, if we can secure the mixture.*

The average composition of monel metal as given by Paul D. Merica of the International Nickel Co., is as follows: Nickel 67 per cent; copper, 28 per cent; and 5 per cent of such elements as iron, manganese and silicon. Thus in one analysis, the manganese was 0.25 per cent; iron, 1.90 per cent; silicon 1.06 per cent, and carbon, 0.18 per cent. The manganese and the iron vary and the missing part of the above analysis can be made up of iron 1 per cent, and manganese 0.61 per cent, and the result will be the alloy known as monel metal.

However, the best procedure will be to purchase the metal, either in the ingot, or some other form, as it will not pay to attempt to make it, and it is doubtful if anyone ever tries.

## Combining Lead with Copper Alloys

*We would like to learn of some process for amalgamating from 50 to 60 per cent of copper with from 40 to 50 per cent of lead, to make a bearing metal that can be remelted without separation of the lead.*

Making *Pot* metal as mixtures of lead and copper used to be called is one of the tricks of the trade with dozens of different ways of performing the trick. It is a case of what is one man's meat, is another man's poison, for a method entirely successful in one foundry, will prove an utter failure in another, a phenomenon responsible for the undoing of many an expert in the making of such *alloy*. Therefore, we will avoid getting into trouble, and will merely state what has been used with success in producing such alloys, then leave it to the inquirer to make good.

Some believe the addition of 1 or 2 per cent nickel, added in the shape of a 50-50 copper-nickel alloy will assist in performing the trick. Others pin their faith on sulphur, and use it in the form of roll sulphur, around 1 per cent, and in the shape of galena, lead sulphide; or carried by a sulphate, such as calcium sulphate, plaster of Paris, or as sodium sulphate, or a mixture of sulphates, with soda ash, borax and salt. In the latter case the plaster of Paris should make all of 50 per cent of the mixture, the other ingredients being added to produce a fluid slag on the top of the metal. Strange to relate, some melters who lean to a hot furnace and lots of oxygen in their metal, are able to produce alloys, so called, of lead and copper without any flux. On the remelt it usually is necessary to use the flux again, which is cheap and does no harm to the resulting product.

## Castings Heat Automatic Machine Tools

*Automatic machine operators complain that our small brass castings of the following analysis heat cutting tools.*

Body of Casting

| | per cent |
|---|---|
| *Tin* | 0.95 |
| *Lead* | 9.22 |
| *Copper* | 76.75 |
| *Zinc* | 13.00 |
| | 99.92 |

Threaded End of Casting

| | per cent |
|---|---|
| *Tin* | 0.95 |
| *Lead* | 8.99 |
| *Copper* | 76.75 |
| *Zinc* | 13.15 |
| | 99.84 |

As the analyses do not total 100 per cent, there is plenty of room for some other element like iron that would be responsible for the hardness of the alloy. The lead content certainly is high enough to give good machining qualities, but better machining alloy will result from the following change:

Melt together: Machineable Mixture.

| | |
|---|---|
| Alloy now in use | 62 pounds |
| Copper | 34¾ pounds |

When liquid, add;-

| | |
|---|---|
| Tin | 1 pound |
| Lead | 2½ pounds |

This formula will produce an alloy that has been extensively used for small brass castings adapted for rapid finishing on automatic machines. If any complaints are received of hardness or toughness from the machine shop, it will be advisable to have analysis made with special reference to iron content. The addition of the new material as in the formula given, will cut down the iron.

## Brass Key Alloy

*We are casting small brass keys of an alloy of about 65 per cent copper, 35 per cent zinc. These castings weigh about 4 ounces each and we dip them to get a brass color. We would like to use a cheaper alloy; one that could be plated and that would also machine without difficulty.*

The following alloy can be tried. Zinc, 85 per cent; copper 10.5 per cent; aluminum 4.5 per cent. It is a hard, strong alloy and due to the high content of zinc is also a cheap alloy.

# Firm Develops Long-Life Mold

## Thousands of Castings Made in a Thin Cast-Iron Mold Lined with Several Layers of Powdered Refractory Material Held Together by a Binder and Coated with Carbon

BY RICHARD MOLDENKE

THE foundryman has always felt that the destruction of the mold every time a casting is poured is an inefficient procedure. Indeed, the making of molds which could be used over again dates back to the bronze age, when implements of warfare and domesticity were made in stone molds the two parts of which were suitably hollowed out, clamped together and poured

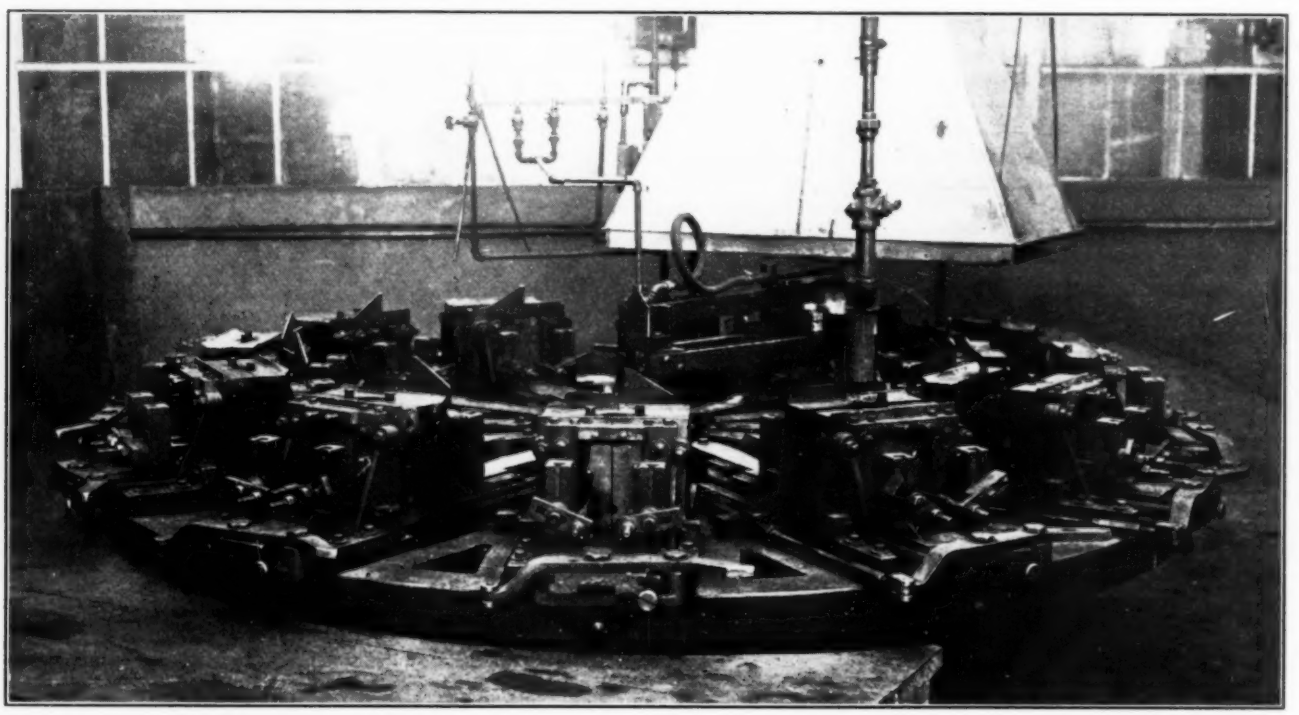

FIG. 1—MOLDS ARE REVOLVED ON A TABLE AND AUTOMATICALLY CLOSED—THEN AFTER THE CASTING IS POURED THE MOLD OPENS AND THE CASTING IS EJECTED—A GAS TORCH PREHEATS THE MOLD AND ANOTHER BURNER SOOTS IT

much as our present brass ingots. These stone molds are in reality of the first *long-life* molds on record. In the development of the iron industry, with molten metal at first only as an undesirable occurence in the operation of the small blast furnaces used, the open-sand mold was the only practical means of caring for the intermittment supply of metal. However, as time went by, and the iron foundry became stabilized, the desire to construct molds which would last for more than one filling without damage asserted itself again and as early as the opening of the last century we have English patent records bearing upon the subject.

While the iron mold—or as we know it under the title of *permanent mold*—has been known and used for perhaps a century and a half, and is today attracting world wide attention in connection with the centrifugal casting process, the method in its simpler forms has never found a solid footing in the foundry industry. The fundamental reason for this is that the molten metal when poured into an iron or steel mold is subjected to entirely different influences than is the case with the ordinary sand mold. The rate of cooling is so much faster, with consequent more sharply defined crystallization effects, and the production of an extremely fine grained structure, if not actual chilling of the metal to whiteness. Even where the attempt is made to approximate the rate of cooling in the sand mold, by suitably preheating the iron mold, this either falls short of the desired situation if the mold is not heated high enough to deteriorate it rapidly; or when preheated sufficiently, pouring must be done at longer intervals unless the life of the mold is to be sacrificed. The consequence has been that while good castings have been made with all the permanent mold processes brought out, the irregularity of product, unless corrected by careful and costly annealing, has militated against their commercial success until quite recently. Therefore, for ordinary practice it seems better to return to the old bronze age idea of using the equivalent of the stone mold; in other words, a mold of the refractory surface properties of sand and yet strong enough to yield a large number of acceptable castings before considerable redressing is necessary or the mold must be discarded. The following conditions would seem to be indicated in developing such a type of mold.

First, the mold surface must be of a highly refractory character so that the least possible heat may be transmitted to the body of the mold to affect the form of the mold as well as seriously limit the rate of pouring iron for castings in-

Paper presented at the convention of the American Foundrymen's association held in Cleveland, April 30 to May 3, 1923.

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note book form.

## SAFETY CODE FOR FOUNDRY WORKERS

(*Continued from Data Sheet No.* 476)

Rule 322. *Drying Ladles*—Where the operation of drying ladles causes fumes or gases injurious to the health of employes within the foundry, ventilating hoods shall be provided and kept in repair for the purpose of effectively removing such fumes or gases.

Rule 323. *Ovens*—All ovens from which fumes or gases injurious to the health of employes escape shall be provided with hoods of sufficient capacity to effectively remove such fumes or gases.

Rule 324. *Height of Ceilings*—No foundry in which zinc-bearing metals are melted or poured shall be operated in a room less than 14 feet in height from the floor to the lowest point of the ceiling, except that where the roof is of peak, saw-tooth or arch construction, the minimum height of the side walls may be 12 feet. If such foundry is installed in the front part of the building the ceiling shall be in every part not less than 6 feet 6 inches above the curb level of the street in front of the building, and if such foundry is installed entirely in the rear part of a building or extends from the front of a building to its rear, the ceiling shall be not less than 3 feet above the curb level of the street in front of the building and the foundry shall open on to a yard or court which shall be not less than 6 inches below the level of the floor.

### PART IV—OPERATING RULES

Section 40. Inspection and Maintenance

Rule 400. *Daily Inspection of Equipment*—All ladles, shanks, crucibles, crucible shanks, crucible tongs, yokes, skimmers, slag hoes, crane chains, cables, ropes and slings used in handling or pouring of molten metal shall be inspected daily in regard to their safe condition by the men preparing and using such appliances.

Rule 401. *Weekly Inspection of Equipment*—A weekly inspection in regard to the same condition of all crane chains, cables and slings in use for suspending molten

(*Continued on Data Sheet No.* 478)



## SAFETY CODE FOR FOUNDRY WORKERS

(*Continued from Data Sheet No.* 477)

metal in mid-air shall be made by a man designated by the employer for that purpose. Written report of such inspection shall be kept.

Rule 402. *Defective Equipment*—Equipment found upon inspection to be defective shall not be used while in that condition.

Rule 403. *Condition of Tools*—All tools shall be kept properly dressed and free from mushroomed heads.

Rule 404. *Riding Chains and Crane Loads*—The practice of riding chains and crane loads shall be forbidden.

Rule 405. *Swinging or Dangling Crane Chains*—Swinging or dangling crane chains must clear all obstructions when the crane is in motion or they must be guided by chainmen walking beneath.

Rule 406. *Removing Crucibles from Furnace*—When the combined weight of a crucible containing molten metal and the crucible tongs exceeds 100 pounds, the crucible shall be removed from the furnace by not less than two men or by mechanical means, and when the combined weight exceeds 300 pounds, three or more men or a mechanical device shall be employed.

Rule 407. *Use of Explosives and Drop Balls*—The use of high explosives or of a drop ball for breaking scrap shall not be permitted unless done under reasonably safe conditions and under expert supervision.

Rule 408. *Locomotives in Foundries*—No locomotive while discharging smoke shall remain inside a foundry during working hours except during such periods as may be necessary for its entrance and exit; but this regulation shall not apply to locomotive cranes nor steam charging machines.

Section 41. Clothing and Protection Worn By Workers

Rule 410. *General Requirements*—Head and eye protectors shall conform to the requirements of the National Safety Code for the Protection of the Head and Eyes of Industrial Works.

(*Continued on Data Sheet No.* 479)

to it. If too much heat passes from the surfaces in contact with the molten iron into the body of the mold, the very purpose of the mold is lost, as it no longer will approximate the regular sand mold. Again, a too hot mold will warp and deteriorate rapidly. Hence the desirability of having the mold light and if necessary air cooled, so that the mold body may not accumulate heat unduly and thus affect the rate of pouring detrimentally. The ideal situation is that of the heat conditions in the green-sand mold from which the casting has been removed just after setting—imagining this possible without destroying the mold. But a small depth of sand will have been seriously affected by the extreme heat, and the outer portions of the mold may still be cold.

Second, the nature of the mold material must be such that no gases are formed during contact with the molten metal, until this has set. There is little chance for venting in such a mold. A momentary consideration of this matter, however, will show that after all it is the fault of the mold if gases are formed which affect the metal surfaces. The chilled roll is a case in point. Here no chance for venting is offered, and yet castings are made which machine up without a defective speck. Further, it is perfectly possible to cast against a firebrick surface successfully, provided the surfaces are entirely dry and preferably warmed. Hence, if the casting surfaces of a long-life mold are of a finely granular and highly refractory nature there need be little fear of bad results due to lack of venting.

Third, the mold surfaces must be sufficiently strong to resist the cutting action of the molten metal, and be impervious to the entrance of fine filaments of iron which on removal of the casting would take some of the mold material with it. Further, the mold surfaces must not spall off. If thoroughly dried the last named action should not eventuate. The strength of the mold surfaces is a question of the bond, and the porosity of the material a matter of the fineness of grain or crystal.

The crucial point in these considerations as to the nature of a desirable mold surface is the rate of removal of heat from the molten metal; whether as slow as in the case of the ordinary sand mold, or fast enough to permit some chilling action. This rate of removal of the heat until the molten metal has safely set depends upon the refractoriness of the material in greatest measure, the temperature of the molten metal and the quantity of metal involved, together with the freezing point and other metal characteristics.

For the various sections of a casting the temperature of any point of contact between mold surface and molten metal will be practically the same at first, but the depth to which the comparatively high temperatures will penetrate the mold mass naturally will depend upon the thickness of the metal which has to set against it. Thus, if in a casting, that portion ¼-inch thick imparts say 1000 degrees Fahr. to a point 1/64 inch within the mold mass, another portion of the same casting 2 inches thick may show 1000 degrees Fahr. at a point 1/16 inch deep within the mold mass before the metal has set. Practically, for long-life mold purposes, it is the nature of this 1/16 inch or less—depending upon the thickness of the castings to be made—that must be carefully considered and conform to the requirements above enumerated. The rest of the mold mass can be any material that is structurally safe to hold the refractory surface true and well bonded, and that will also absorb the heat passed through the mold surface material and promptly dissipate it. In other words, a cast-iron backing to a refractory mold material forming a contact surface for the molten iron, is an ideal combination when the refractory facing of the mold is heavy enough to transmit heat at the proper safe rate, and the iron backing is light enough to dissipate the heat transmitted into it quickly.

With the above underlying principles involved in the construction of the long-life mold thus enunciated, it is the purpose of the writer to show how the problem of adapting these principles for every-day practical application have been worked out into a system by the Holley Carburetor Co., Detroit, and to show illustrations of the machines built for the purpose. When it is stated that by this time some of the molds have already had 10,000 castings made in them and by reason of a close daily inspection of, and attention to, the refractory facing material of the molds not one of them has yet had to be discarded, the writer feels that here is truly a new development in making long-life molds. The term *long-life* is used advisedly as against *permanent*, for in the latter the supposition is that no repairs are made on the metal mold, whereas in the former, repairs are possible and are carried out until they no longer pay. The period of use varies.

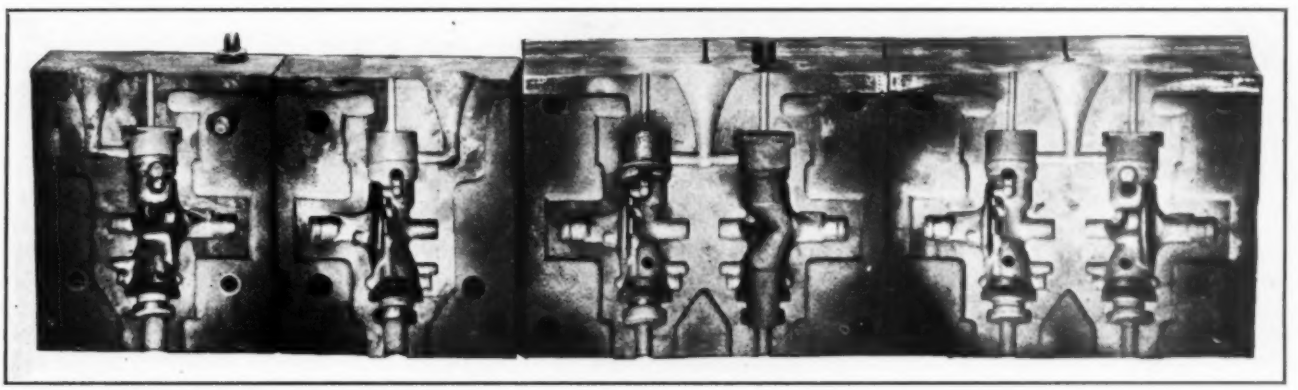

FIG. 2—A MOLD FOR A SINGLE CASTING IS SHOWN AT THE LEFT, WHILE THE TWO HALVES OF A MOLD FOR TWO CASTINGS IS INDICATED AT THE RIGHT—THE SECOND MOLD FROM THE RIGHT END CONTAINS CORES

The system devised by the Holley Carburetor Co. has been carefully worked out in every detail and is fully patented. The several steps and the reasons for operating just that way are given in the following description. As previously indicated, the primary idea has been to make a light cast-iron mold, the surface of which is covered with a layer of highly refractory material, of necessary thickness, and this refractory material so protected from abrasion and penetration of fine iron filaments, that it almost wears to a polished surface and only on rare occasion need be patched up or refaced. For operating purposes, where the castings are not large, a group of molds are placed upon a revolving table and the several steps of the cycle can be carried out almost completely automatically. Where the castings are larger and a table of three to eight molds would be cumbersome, single molds would be operated as long as molten metal is available.

The refractory material forming the mold surface consists of two items. The refractory material itself, and the binder to bond it to the iron backing. The refractory material can be any of the usual

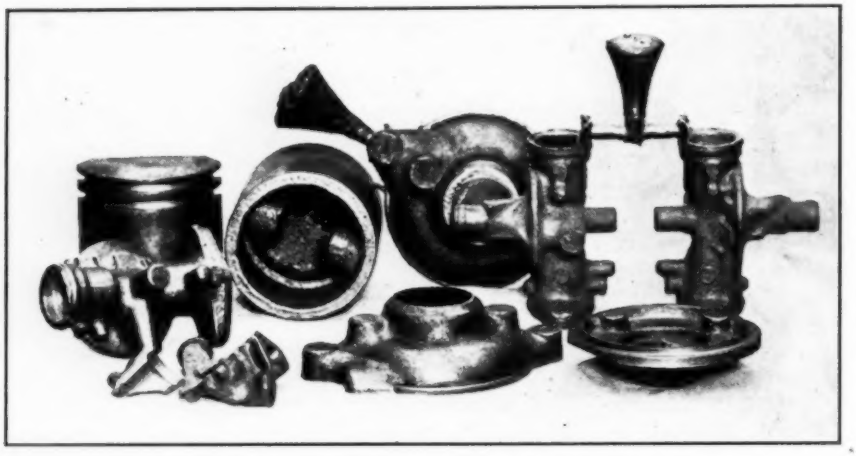

FIG. 3—CASTINGS MADE IN A LONG-LIFE MOLD

substances used to resist heat in the arts. Thus, magnesia, bauxite, fireclay or kaolin will serve. The grain must be exceedingly fine and in the application heat must be used finally so that no question of gas forming constituents remaining in the mass may arise. The binder must be a mineral one, an alkali silicate being most convenient, so that when heat has been applied the mass is like a thin sheet of stone. The material is preferably put on in comparatively thin layers, and each one baked on before the next is applied. For the heavier facings, the final layers can be applied by transfer from what would be a metal pattern, so that the accuracy of the finished long-life mold leaves nothing to be desired.

The final heating—in effect a skin-drying at temperatures to almost vitrify—being accomplished, the molds are placed in their proper position on the revolving table, and successively follow their prescribed course. In passing around, the two parts of the mold are drawn apart sufficiently to allow the setting of cores, but just before this each mold successively passes a flame of acetylene gas which smokes the inner surfaces heavily. The idea is to interpose a film of carbon between the refractory surface and the molten metal of sufficient strength to effectively prevent any scoring action, or the actual contact of metal and refractory material. This must act for the instant of greatest temperature effect. Most of the carbon is absorbed by the metal, but the effect is that until the molten metal is no longer dangerous, the refractory material is protected. After passing the flame and the position where cores can be set, the two parts of the mold are made to close automatically and are held thus until poured and the metal has set sufficiently. Then they are quickly opened and the castings are forced out by pins, or by other suitable means. Next, the blast of air at high pressure rapidly blows the surfaces clean and the mold passes before the acetylene flame again. The man setting the cores, or in their absence, any attendant watches for the mold surface conditions as the molds pass by open, and any fragment of iron or core left inthe mold is easily seen. It is removed with a suitable tool.

FIG. 4—BATTERY OF THREE REVOLVING TABLES CARRYING SETS OF MOLDS

The iron backing of the mold has been stated as comparatively thin. This allows—particularly if constructed with that in view—the use of air-cooling action, and where such an air blast is in use for cooling the iron molds a little faster than they would normally do it, the machine can be speeded up so as to give a larger production.

Whether pouring is done by hand or from suspended ladles; whether the man remains stationary while pouring as the mold passes him, or moving platform accompanies the table; whether the molds and cupola are together, or iron has to be carried from a distance; and lastly, whether molds are poured all day long or merely the usual 2 or 3 hours, depends upon the individual situation. It may be of interest to state that with 12 single molds on the revolving table, one man can pour 400 castings of a given kind per hour. With sand casting it takes eight times the number of man hours to get an equal number of the same kind of castings. Further, from the nature of the pour-top pour it is possible to feed the molds more perfectly and hence the castings made are almost free from shrinkage even with considerable variation in sections. This makes for denser metal and the consequent benefit to strength conditions, etc.

While the process is still in its infancy and attention has naturally been given to quantity production of the comparatively light castings required at the Holley Carburetor works, nevertheless many automobile pistons have been made. It will become a matter of heavier refractory coatings, and more frequent repair of exposed points in these coatings, when larger work is undertaken.

### On Revolving Table

Of the illustrations given, Fig. 1 shows a group of long-life molds arranged on the revolving table and ready for the pouring operation. Directly at right end of the wooden platform a mold may be noted just closing. The next five molds may be seen as closed. Pouring is done while the molds pass the wooden platform. The metal sets properly while the table brings the molds successively to the position of the one under the last pipe at the left, where the molds open for the ejection of the castings. At the next position toward the right the mold face is blown clean, then it comes before the acetylene flame as shown directly under the hood. Here the mold face is smoked, the excess smoke being drawn away with the products of combustion. The molds are now wide open, and at the extreme right of the table three molds may be seen fully open for inspection and the setting of cores. The cycle then repeats itself.

Fig. 2, shows the molds more plainly,

a set each of a one and a two-casting mold being indicated. The arrangement for pouring basin, core vents and gating is plainly shown. A core has been set in the third mold from the left. Holes in the molds extending to the surface of the casting are filled with suitable pins which push inward as the molds open and thus eject the castings automatically.

Fig. 3, shows some of the castings as ejected from the molds and partly machined; also a broken casting with uniform, fine-grained fracture, easily machinable and without a sign of chilling. The piston casting shows some thick sections, not being cored for the pin. The pair of castings connected with the gate, at the extreme right, are interesting as being taken from the right-hand mold pair of Fig. 2. The cores have been removed. Fig. 4, shows two of the tables in operation. Pouring off may be observed in the first table, and the smoking of the molds on the first and second. Successful results have also been obtained by spraying the molds with a film of graphite in oil, the heat of the molds driving off the oil almost immediately. This method would doubtless be more economical for larger molds. It has been of great interest to the writer to observe the operation of the Holley development. For many years he has advocated leaving the permanent molds idea in favor of the long-life mold, as giving promise of better results, if not as spectacular. The principles involved have also been discussed by the writer, but until the Holley Carburetor Co. had worked out the problem step by step and had provided for the several contingencies mentioned in connection with the requirements of the mold surface, nothing comprehensive in this line had come before the foundry industry.

## British Research Active

The March monthly circular of the British Cast Iron Research association indicates considerable activity. The special committee dealing with the standard test bar specification promises a special report, a basis having been decided. Progress has been made with the research on internal combustion engine castings following the examination and defective castings and a specification for air cooled and jacketed cylinders for automobiles has been approved. The research on shrinkage defects has been made to include liquid shrinkage, solid contraction, physical properties, corrosion, etc., and an early report is promised containing valuable data. Consideration is being given to standard specifications for cast iron for piston-ring pots and concentric piston rings. A large number of problems sent in by members have been dealt with by the director. The library has been considerably enlarged and a catalog is to be issued shortly. Attention is called to the increasing competition of drop forging, emphasising the necessity of more scientific practice.

Calling attention to research in America, the circular states: The production department of the United States chamber of commerce reports that American industries are spending $70,000,000 annually on scientific research. As a result of this work it is estimated that one half billion dollars are being saved annually by American industry.

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The foundry department of the National Radiator Co., New Castle, Pa., is being enlarged to double its capacity.

## Use Steel in an All-Scrap Mixture

*By H. E. Diller*

*Question*—We are casting a plate 3 feet 6 inches in diameter, 1 inch thick, which we are chilling on one side. This plate must not crack when struck a heavy blow. We are now using an all-scrap mixture and want to know whether the addition of 20 to 30 per cent steel would be a benefit. Would horseshoes or boiler plate be satisfactory, or should we order steel ingots?

*Answer*—In making the castings you propose to make out of an all-scrap mixture, 20 to 30 per cent of which is steel, you would be apt to get the iron too hard on account of the low silicon and would not materially increase the ability of the casting to resist shock, over an iron with 10 to 15 per cent steel in the mixture. If your gray-iron scrap averaged 2 per cent silicon, the addition of 20 per cent steel scrap in the mixture would lower this 20 per cent, to 1.6 per cent. Thirty per cent steel scrap would lower the silicon in the mixture to 1.4 per cent. Allowing 0.2 per cent loss in the cupola, this would leave you either 1.4 or 1.2 per cent silicon in your casting, which would be rather low, especially when with an all-scrap mixture you take the chance that the silicon in the iron will be lower than figured. You would get a better casting by using the chill, then taking the casting out of the mold as soon as the metal sets and putting it into a soaking pit or furnace to cool. Horseshoes or boiler plate scrap would be satisfactory, but the boiler plate could not be in too large pieces which would be apt to retard the blast if a piece fell flat across the section of the cupola. It would not be necessary to buy steel ingots. However, you might find it profitable to secure a little ferrosilicon or high-silicon iron to control the chill.

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The Hall-Elder-Hendry Co. has been incorporated to take over the property of the Elder & Hendry Foundry Co., Columbus, O. The offices of the new company will be in the Guarantee Title & Trust building. Officers elected are: J. Elliott Hall, president; John F. Elder, secretary and treasurer; and Albert L. Hendry, general manager.

# Studies Automotive Castings

## Data Collected and Compiled Shows Variations in the Constituents of Metal Used by Different Manufactureres—Total Carbon Content Governed by Height of Bed—Steel Additions Do Not Lower It

BY H. B. SWAN

SOME time ago the writer was requested to prepare something on gray iron mixtures for automotive castings. It hardly seemed as though a sufficient amount of new data to warrant such a paper had developed since the writer had previously presented a paper before the 1913 meeting of this association on this same subject. However, it appeared that some discussion of the general practice in this country on that subject might be of interest. With this in view, it was suggested that a questionnaire covering the data required be prepared and sent to a representative list of the foundries supplying the automotive industry. About 25 foundries comprised the list prepared and replies were received from 16. Many of the latter were incomplete in the answers.

In regard to the cupola data asked for, it was thought interesting to find out whether the present day practice approached anything which might be called standard. Furthermore, the writer desired to check up some personal observations regarding the total carbon content. The amount and condition of the total carbon is to the writer a point of prime importance for such work as cylinders. Fuel ratio, the percentage of pig iron, remelt and steel are important both technically and economically. The amount of remelt which can be used without detriment to the casting is a point often discussed. The question of what mixture the foundryman shall use depends on several factors. It may happen that the buyer furnishes certain specifications by which the foundryman must be guided to some extent in compiling his mixture. Special physical tests are not uncommon. In other instances the composition is left entirely to the judgment of the foundryman. Of course, good machining qualities and freedom from the usual foundry defects are understood.

As an instance of special requirements, the writer recalls a rather difficult exhaust manifold which the foundry was called upon to make. This casting was polished all over the outside surface previous to a bake enamel. Being a thin-walled casting with some comparatively heavy bosses and flanges, it required considerable experimenting to get iron which filled all requirements satisfactorily. Another instance, is a company which requires that the barrels of the cylinder block shall conform to a brinell test within certain limits. It often requires the best judgment of several years' experience and some experimental work to meet special specifications for a peculiar casting.

Automotive castings may be conveniently divided into the following classes:

Cylinders, cylinder heads.
Pistons.
Crankcases and transmission cases.
Flywheels and gear blanks.
Miscellaneous small castings, such as manifolds, pumps, covers, etc.
Piston rings.

### Problems Vary

In making this division, due consideration is made for the shop wherein questions of tonnage, melting capacity, ability to take care of special mixtures from the same cupola, price, etc., are questions of vital importance. On the other hand, a special iron will oftentimes cut down losses and be an economy in the end, in addition perhaps, to meeting the service requirements of the casting most suitable. For instance, for cylinder blocks, which are not cast integral with the upper crankcase, it is desirable to have them as hard as the machining will stand. The writer's observation, extending over a period of years, is that hard barreled cylinder blocks wear best in service. This statement is made on the basis of the number of cylinders returned from service for regrinding, from each year's model.

In the writer's experience, cylinders of a proper hardness and composition will run from 30,000 miles to better than 50,000 miles in some cases before needing to be reground. Of course, there are several factors in motor operation which govern the wearing qualities of the barrels, notably, lubrication and the richness of the explosive mixture. Cylinders cast integral with the crankcase and crankcases themselves, usually require a softer and tougher iron, due to the thin walls and large area to be covered and liability to cracks.

Piston rings are a specialty in themselves, and pistons are better made from special mixtures. Flywheels and gear blanks could well be made in the miscellaneous class, but for the fact that where teeth are cut in them a harder iron wears better. Cylinder iron is usually satisfactory for these castings.

For a detailed method for computing mixtures allowing for losses, the effect of varying the element constituents in gray iron, etc., those unfamiliar with the practice are referred to Dr. Moldenke's book on Foundry Practice, and to such articles as Dr. John J. Porter's "Constitution of Cast Iron" Vol. XIX, A. F. A. *Transactions*. A few words along this line, however, may not be amiss. For the foundry making the forementioned classes of castings, a fair assortment of pig iron in the yard is quite desirable, if not necessary. This stock preferably may include, first a grade of foundry iron best adapted to the general run of work in the shop; secondly a silvery iron (7 to 10 per cent silicon); malleable bessemer; perhaps charcoal iron for special purposes, and selected scrap and scrap steel.

For such work as cylinders, the writer has found that in using scrap steel better results are obtained in the use of steel of fairly good section, such as rails, medium forgings or heavy boiler plate clippings. Drop forge flashings are cheaper but light, and oxidize more readily. Where more than one mixture is used in a shop it is necessary to use care in keeping the remelt separated, if castings of uniform analysis are to be obtained. Under these conditions it is possible to easily vary and control the silicon, manganese, phosphorus and sulphur contents. Silicon is controlled by varying the amount of silvery iron and scrap steel used, manganese by the use of the ferroalloy or spiegel, phosphorus in amount of steel used and perhaps by using some

Paper presented at the convention of the American Foundrymen's association, held in Cleveland, April 28 to May 3. The author is foundry superintendent, the Cadillac Motor Car Co., Detroit.

high phosphorus pig if it be necessary to raise its percentage; sulphur can to a lesser extent be controlled through the manganese content and by the temperature of melting and slag proportionment. (See J. W. Bolton, THE FOUNDRY, Sept. 1, 1921.)

The carbon content is much more difficult to control, for the iron will take up carbon to the saturation point, depending on the temperature and silicon content, a mixture with a high silicon content, that is, 2.75 to 3.00 per cent, and fairly high sulphur, tends to reduce the total carbon. Moreover, melting lower than the correct level above the tuyeres in the cupola has the same tendency.

**TABLE I—DATA ON IRON FOR CYLINDERS**

| Number | Silicon | Manganese | Phosphorus | Sulphur | C. Carbon | G. Carbon | Total Carbon | Pig Iron | Remelt | Steel | Fuel Ratio | Tuyere Ratio | Blast Pressure | Diam. of Cupola inside Lining inches | Tensile Strength, pounds per sq. in. | Trans. Load, Breaking 1¼-inch diameter ar. bar, 12-inch centers | Deflection, in inches | Brinell Hardness |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Per Cent | | | | | | | | | | | | | | | | | |
| 1 | 2.10 | 0.80 | 0.20 | 0.08 | 0.50 | 2.70 | 3.20 | 40 | 45 | 15 | 1:27.27 | 1: 5.9 | 12 | 54 | | | | 185 |
| 2 | 2.50 | 0.60 | 0.55 | 0.15 | 0.45 | 3.10 | 3.55 | 35 | 40 | 25 | 1:5 | 1: 5 | 15 | 72 | 40000 | 3100 | 0.18 | 185 |
| 3 | 2.25 | 0.65 | 0.20 | 0.10 | 0.40 | 3.00 | 3.40 | 34.3 | 45.7 | 20 | 1:7 | 1: 5 | 18 | 78 | 30000 | 3000 | 0.15 | 201 |
| 4 | 2.20 | 0.65 | 0.30 | 0.09 | 0.20 | 3.30 | 3.50 | 45 | 45 | 10 | 1:8.3 | | 11 | 60 | 34000 | 3800 | 0.17 | |
| 5 | 2.40 | 0.60 | 0.22 | 0.10 | 0.35 | 3.00 | 3.35 | 43.4 | 40.6 | 16 | 1:6.6 | 1:10.9 | 13 | 66 | | 3000 | 0.14 | 181 |
| 6 | 2.20 | 0.65 | 0.45 | 0.09 | 0.50 | 2.90 | 3.40 | 50 | 37.5 | 12.5 | 1:6.8 | 1: 4.7 | 16 | 60 | 33000 | 3300 | 0.12 | 217 |
| 7 | 1.75 | 0.55 | 0.25 | 0.08 | | | | 50 | 30 | 20 | 1:8.3 | 1: 5.5 | 13 | 54 | 33500 | 3350 | 0.16 | 207 |
| 8 | 2.10 | 0.60 | 0.22 | 0.095 | 0.60 | 2.80 | 3.40 | 55 | 25 | 20 | 1:7.7 | 1: 2.25 | 14 | 60 | 27400 | 3800 | 0.135 | 197 |
| 9 | 2.25 | 0.60 | 0.25 | 0.10 | 0.45 | 2.80 | 3.25 | 48.9 | 39.1 | 12 | 1:8.5 | 1: 8.0 | 14 | 54 | 37500 | 3100 | 0.14 | 192 |
| 10 | 2.10 | 0.60 | 0.20 | 0.095 | 0.60 | | | 56.0 | 32 | 12 | 1:9.2 | | 16 | 64 | | | | 190 |
| 11 | 2.85 | 0.50 | 0.18 | 0.15 | 0.50 | 2.40 | 2.90 | 42 | 40 | 18 | 1:7.4 | 1: 3.75 | 11 | 48 | 27500 | 3750 | 0.16 | 175 |
| 12 | 1.90 | 0.70 | 0.18 | 0.08 | 0.50 | 2.90 | 3.40 | 38 | 44 | 18 | 1:6.66 | 1: 5.4 | 14 | 54 | 30400 | 4300 | 0.13 | 170 |
| 13 | 2.00 | 0.65 | 0.20 | 0.095 | 0.50 | 3.20 | 3.70 | 40 | 44 | 16 | 1:8.5 | 1: 6.1 | 16 | 70 | | | | 175 |
| 14 | 2.50 | 0.70 | 0.25 | 0.09 | 0.40 | | | 53.5 | 34 | 12.5 | 1:7.5 | 1: 4.1 | | 52 | | | | |
| 15 | 2.70 | 0.55 | 0.20 | 0.10 | 0.50 | 2.70 | 3.20 | 40 | 37.5 | 22.5 | 1:5.9 | 1: 4.25 | 11 | 54 | 32500 | 3300 | 0.125 | 200 |
| 16 | 2.05 | 0.60 | 0.15 | 0.09 | 0.60 | 2.80 | 3.40 | 43.3 | 36.6 | 20 | 1:6.66 | 1: 4.8 | | 72 | 36000 | 4400 | 0.25 | 212 |
| * | 1.20 | 0.80 | 0.35– | 0.12 | 0.50– | | 2.70– | | | | | | | | | | | |
| A | 1.80 | Max. | 0.80 | Max. | 0.80 | | 3.50 | | | | | | | | | | | |
| * | 1.20 | 1.10 | 0.60– | 0.12 | 0.50– | | 2.70– | | | | | | | | | | | |
| B | 1.80 | Max. | 1.20 | Max. | 0.80 | | 3.30 | | | | | | | | | | | |

* The British Engineering Standards Association Specifications for water cooled air craft cylinders. Foundry Vol. 1-3, Feb. 1, 22.

Higher melting has the opposite effect. Then with a full understanding of the relations of each element and their functions, together with close melting control, it is not difficult to run an iron mixture from day to day with a small variation in composition. Of course, it is understood accurate information is at hand concerning composition of all the raw materials affecting the final product and frequent analysis, hardness tests, fracture examinations, pouring temperature observations, and sometimes physical tests are necessary adjuncts to close control and getting the most desirable results.

### Figures Averaged

Referring to the tabulated data shown in Table I, it is to be noted that the information shown is representative of the practice of the largest corporation foundries in this country, making casts for cars from among the cheapest makes to the most expensive. Where a range of figures was submitted, the writer has averaged them and used the average figure in the table. For instance, where a silicon content is reported as from 2.05 to 2.15 per cent the value used is 2.10 per cent. Figures are treated similarly in the columns under tensile strength, hardness, etc.

### Pig Iron Used Varies

The column giving the percentage of pig iron used in the mixture shows a range of from 34.3 to 56 per cent with an average of 44.1 per cent. The experience of the writer has been that it is not advisable to run a mixture with less than 40 per cent pig iron for cylinder work. The proportion of steel scrap and remelt to be used depends upon conditions, such as the amount of remelt available in your own shop and from the rejections from your buyers, also on market conditions. It is easier to buy uniform steel scrap than uniform gray iron scrap.

Again referring to the tabulated data it is found that the percentage of remelt, scrap, sprues, gates, etc., varies from 25 to 45.7 per cent, with an average of 38.5 per cent, and the scrap steel content from 10 to 25 per cent, averaging 16.8 per cent. The advantages and disadvantages, if any, in the addition of scrap steel to a mixture have been so widely talked of that it is unnecessary to discuss them here. Steel is a handy tool for the formulator of the mixtures, as previously pointed out, and in the writer's experience, under proper melting conditions there is little to be said against its use. For this class of work, however, most of the desired results can be obtained with the use of from 15 to 20 per cent of steel.

Considering the use of steel scrap in the cupola from the purely physical benefits to be derived, the prime object in its use is the closing up of the grain of the iron. In so far that higher percentages reduce the total carbon content of the spout metal, in the opinion of the writer, this is extremely doubtful. Much more control of the total carbon is to be found in varying the silicon content and in the height of the melting zone in the cupola. That height of melting zone in the cupola which gives the hottest iron will also give the highest total carbon for a given mixture and raising the percentage of steel will reduce the carbon but slightly. Lowering the melting zone will both lower the temperature of the metal and reduce the carbon.

### Little Influence on Carbon

A glance at the columns under total carbon, and under percentage of steel, shows that the steel has little influence on the carbon. In No. 1, with 15 per cent steel, a total carbon content of 3.20 per cent is found, whereas in No. 2, with 25 per cent steel, the total carbon content is 0.35 per cent higher, or 3.55 per cent. No. 11 shows the lowest total carbon, coincident with the highest silicon and sulphur contents, and its steel ratio is lower than No. 2. The following equation taken from the "Constitution of Gray Iron," by J. J. Porter, A. F. A. *Transactions*, Vol. XIV, gives a fair idea of the effect of the other elements on the total carbon: Per cent total carbon equals 4.23 minus 0.27 x per cent silicon minus

0.32 x per cent phosphorus minus 0.3 x per cent sulphur plus 0.03 x per cent manganese.

He adds: "The sum of the graphite and combined carbon is dependent upon the conditions of melting in the blast furnace and in the cupola; and upon the percentage of silicon, sulphur and manganese. * * *"

As a matter of comparison, the writer has put in Table I the specifications of the British Engineering Standards association for water-cooled air craft engine cylinders. It is to be noted that the graphite is held fairly low in both sets of figures, the silicon is lower, the manganese higher, and the phosphorus much higher, than steel or iron arbors for the barrel cores covered with only a thin layer, from 3/16 to 5/16 inch of sand, and by allowing a free circulation of air beneath the bottom board through the arbors and through the cope if the cylinder is molded on end. This procedure will raise the hardness of the barrels about 30 to 40 points on the brinnel scale. Furthermore, low total carbon is desirable. That is a cylinder from an iron containing 0.50 to 0.60 per cent combined carbon and about 2.50 to 2.75 per cent graphite is preferable to one with the same percentage of combined carbon and 3.00 per cent or over of graphite.

A further study of the question-

of the range. This practice of using low phosphorus has increased extensively in the last few years, and is due to the fact that the cylinder manufacturer seeks to eliminate the segregation of the fluid phospho-carbides. In doing this, with a low silicon mixture, much of the fluidity of the iron is sacrificed, thereby necessitating hotter melting, which means higher total carbon. The factor of strength does not enter into consideration in this class of work, and the irons with higher phosphorus contents are sufficiently strong, indeed, they will average well with the lower phosphorus irons.

For obtaining cylinder bores with

**TABLE II—DATA ON IRON FOR PISTONS**

| Number | Silicon | Manganese | Phosphorus | Sulphur | C. Carbon | G. Carbon | Total Carbon | Pig Iron | Remelt | Steel | Tensile Strength pounds per sq. in. | Trans. Load, 1¼-inch dia. ar. bar 12-inch centers | Deflection, inches | Brinell Hardness | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Per Cent | | | | | | | | | | | | | | |
| 1 | *2.10 | 0.80 | 0.20 | 0.08 | 0.50 | 2.70 | 3.20 | 40 | 45 | 15 | ..... | .... | .... | .... | Same mixture as used for cylinders. |
| 2 | *2.50 | 0.60 | 0.55 | 0.15 | 0.45 | 3.10 | 3.55 | 35 | 40 | 25 | ..... | .... | .... | .... | Same mixture as used for cylinders. |
| 3 | 2.40 | 0.55 | 0.18 | 0.10 | 0.30 | 3.10 | 3.40 | 40 | 44 | 16 | 27000 | 2700 | 0.16 | 192 | Special mixture for pistons. |
| 4 | *2.20 | 0.65 | 0.30 | 0.09 | 0.20 | 3.30 | 3.50 | 45 | 45 | 10 | ..... | .... | .... | .... | Same mixture for all classes. |
| 5 | 2.50 | 0.60 | 0.22 | 0.10 | 0.35 | 3.10 | 3.45 | 46.7 | 41.3 | 12 | ..... | 2800 | 0.14 | 174 | Special mixture for pistons. |
| 6 | 2.60 | 0.65 | 0.50 | 0.06 | 0.25 | 3.25 | 3.50 | 50 | 45 | 5 | 30000 | 3000 | 0.12 | 192 | Mixture used for all small work. |
| 7 | *1.75 | 0.55 | 0.25 | 0.08 | ..... | ..... | ..... | 50 | 30 | 20 | 33500 | 3350 | 0.16 | 207 | Same mixture as used for cylinders and crankcases. |
| 8 | *2.10 | 0.60 | 0.22 | 0.09 | 50.60 | 2.80 | 3.40 | 55 | 25 | 20 | 27400 | 3800 | 0.135 | 197 | Same mixture as used for cylinders. |
| 9 | 2.50 | 0.60 | 0.30 | 0.09 | 0.29 | 3.15 | 3.40 | 56.5 | 41.3 | 2.2 | 24000 | 2450 | 0.16 | .... | Miscellaneous small castings. |
| 10 | *2.10 | 0.60 | 0.20 | 0.09 | 50.60 | .... | .... | 56 | 32 | 12 | ..... | .... | .... | 190 | Same mixture used for all classes of work. |
| 11 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | No data given. |
| 12 | 2.50 | 0.70 | 0.15 | 0.07 | 0.45 | 3.00 | 3.45 | 45 | 40 | 15 | 24200 | 3400 | 0.12 | 160 | Special mixture for pistons. |
| 13 | 2.40 | 0.65 | 0.30 | 0.09 | 50.35 | 2.95 | 3.30 | 40 | 44 | 16 | ..... | .... | .... | 165 | This mixture used on all classes except cylinders. |
| 14 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | No data given. |
| 15 | 2.75 | 0.55 | 0.20 | 0.10 | 0.40 | 2.95 | 3.35 | 40 | 50 | 10 | 31000 | 3100 | 0.125 | 180 | This mixture also used for flywheels. |
| 16 | 2.35 | 0.60 | 0.18 | 0.09 | 0.55 | 2.95 | 3.50 | 43.3 | 46.7 | 10 | 28000 | 3400 | 0.187 | 196 | This mixture also used for crankcases. |

* Same iron as used for cylinders.

the average American practice. To the writer's knowledge, neither the Society of Automotive Engineers nor the American Society for Testing Materials have any specifications for automotive castings which could be used for comparison.

As previously stated, the writer's experience shows that cylinders with hard bores give better wearing service. Hardness is a function of grain size as well as composition, and the grain size is a variable with the rate of cooling. The part of the bore of a cylinder which is surrounded by the water jacket is usually the softest part of the casting, and is softer than a test bar, up to 1-inch section, which is poured from the same ladle, due to the different cooling effects. The barrel of the average automotive cylinder is seldom over ½ inch in thickness as cast. The sand of the water jacket core and of the heavy barrel core holds the heat so long that an annealing action is obtained in this portion of the barrel. This can be prevented to some degree by the use of hollow

naire shows a silicon range from 1.75 to 2.85 per cent with the greater number using 2.10 per cent. All points considered, for the average run of cylinder work this is a satisfactory content to use. Used in conjunction with low phosphorus, it has one disadvantage in that it is provocative of more shrinkage cavities than such a mixture as No. 11. However, if the total carbon is on the low side, the iron sets quickly enough in all sections to overcome this to some extent.

### Manganese Runs Heavy

The manganese content, as shown in the table, is remarkably uniform, ranging from 0.5 to 0.8 per cent. Generally speaking, it would seem a slight excess of manganese over the theoretical amount necessary to take care of any ill effects from the sulphur is all that is necessary, although it, perhaps, has some benefits as a deoxidizer.

The phosphorus ranges from 0.15 to 0.55 per cent with the predominating tendency toward the lower end

a high degree of hardness, there is much to be said in favor of the high phosphorus mixtures such as are typified by the examples shown above of the British Engineering Standards association, and discussed by F. J. Cook in his paper at the Rochester convention of the American Foundrymen's association last year. These irons hold their hardness through the cooling range, due probably to the predominating phosphide constituent; and the total carbon content is usually considerably lower than low phosphorus irons of the same silicon content. Unfortunately, in the experience of the writer, with the pig irons obtainable in this country, segregation is a frequent and difficult problem to control when such mixtures are used on complicated castings. With low phosphorus irons, the writer's experience has been that the defects due to leaky walls is much reduced.

The column under sulphur in Table I shows a range from 0.08 to 0.15 per cent, with the average about 0.095 per cent. Present day practice shows an increase in the sulphur content of

most grades of castings in this class of work. Some arguments can be set forth favorable to a higher allowable sulphur content than was formerly thought possible to use without serious detriment to the casting. Now for this class of gray iron, a predominating pearlitic structure is highly desirable. This is entirely in accord with the statement of the writer, made in 1913 (Transactions A. F. A., Vol. XXII,) and also with the results stated by Zimmerschied (Transactions A. F. A. Vol. XXIII) in his paper on "Cast Iron with Unusual Structure." A reference to the Iron Age of Dec. 30, 1915, shows some of the high strength results obtained in Europe in experiments with sulphur in high limits in gray iron. Evidently a sulphur content of 0.15 per cent is not so high as to be detrimental. However, the writer believes that with the sulphur at such percentage the silicon should be increased somewhat. The writer knows of one cylinder foundry which has been using for several years with good results, a mixture having the silicon averages about 3.0 per cent, the sulphur 0.15 per cent, and the phosphorus under 0.20 per cent.

### Should Machine Satisfactorily

For a serviceable mixture silicon should be between 1.80 and 2.10 per cent; manganese from 0.50 to 0.80 per cent; phosphorus from 0.15 to 0.20 per cent; sulphur from 0.08 to 0.12 per cent; combined carbon from 0.50 to 0.60 per cent, and graphitic carbon from 2.50 to 2.75 per cent. Such a casting should machine satisfactorily, give a close grain, and wear well in service.

By machining satisfactorily is meant that a cylinder block cast from this mixture can be milled with a cutter speed of from 60 to 80 feet per minute with a cutting depth of ⅛ of an inch, and bored with a cutting speed of 45 to 50 feet per minute with a ⅛-inch cut.

Furthermore, such an iron will have a transverse breaking strength above 3500 pounds on the arbitration test bar and a tensile strength of over 30,000 pounds per square inch. These figures are conservative and taken from actual results in the practice of the writer with iron of the foregoing analysis, save that the total carbons were higher—about 3.50 per cent. The difficulty in obtaining such iron is in getting the total carbon down to the figures indicated.

The fuel ratio is found to vary from 1:5 to 1:9.2, with an average of 1:7.33, which is a good ratio considering the steel additions and that this class of work is fairly light and needs to be poured hot. Coke used on the bed is not included in the figures given for ratios.

Under the column on tuyere ratios a great divergence in practice is shown with ratios varying from 1:2.25 to 1:10.9. With the exception of Nos. 5 and 10, they are all lower, under 1:6, averaging 1:4.73. Some authorities give 1:7 as the proper proportion, whereas others say about 1:4. Judging from data submitted, there is no standard for fuel ratios. A comparison of the tuyere ratios to the fuel ratios does not add any light on the subject for No. 8, with a tuyere ratio of 1:2.25 and a fuel ratio of 1:7.7 is little different in fuel consumption than No. 9 with a tuyere ratio of 1:8. It hardly seems possible that there should not be a ratio between the area of the tuyeres and the area of the cupola which gives the best melting conditions. More data on cupola design is needed.

Table II on pistons shows the data on iron used for pistons arranged under the same numbers as in Table I. Some replies gave no data on pistons so the spaces opposite those numbers are vacant. Those showing asterisks indicate the same iron used as for cylinders. It is to be noted here that among those using a special iron for pistons the silicon content is higher, running from 2.35 to 2.75 per cent. The manganese, phosphorus and sulphur percentages are about the same as for cylinder iron, and the combined carbon is lower, averaging about 0.35 per cent as against 0.47 per cent for cylinders. The total carbons are about the same as for cylinders. The percentage of pig iron used is a little higher, averaging better than 45 per cent, but the percentage of steel is lower, averaging only about 11 per cent. The average percentage of remelt is thereby raised slightly, being about 44 per cent. These figures would be changed but little, even if the mixtures as indicated for cylinders were included. The drop in strength is quite noticeable. This is to be expected from the difference in analysis.

### Pistons Are Light

Present day practice is to make pistons as light as possible, and generally with green-sand cores. They can be cast with wall thickness as low as 3/32 inch. Such light sections tend to cause chilled spots when using mixtures with low phosphorus. The wrist pin bosses are heavy and it is difficult to prevent shrinkage cavities between these bosses and the wall of the piston. A higher silicon content, say from 2.50 to 2.75 per cent, is desirable, for it serves several purposes, counteracting the shrinkage above mentioned, minimizing the blows, and counteracting the chilling tendency of the quick setting iron. Hot melting is essential, for the metal should come from the spout hotter than 2600 degrees Fahr. Another trouble of considerable importance with such light castings is the loss due to cracks. Many machine shops use air expanding

**TABLE III—ANALYSES OF METAL FOR MISCELLANEOUS SMALL CASTINGS**

| Number | Silicon | Manganese | Phosphorus | Sulphur | C. Carbon | G. Carbon | Total Carbon | Pig Iron | Remelt | Steel | Tensile Strength, pounds per sq. in. | Trans. Load, Breaking 1¼-inch diameter ar. bar, 12 inch centers | Deflection, inches | Brinell Hardness | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Per Cent | | | | | | | | | | | | | | |
| 1 | 2.30 | 0.60 | 0.40 | 0.08 | 0.40 | 2.80 | 3.20 | 40 | 60 | .... | .... | .... | .... | .... | Same mixture as used for crankcases. |
| 2 | 2.50 | 0.60 | 0.55 | 0.15 | 0.45 | 3.10 | 3.55 | 35 | 40 | 25 | 40000 | 3100 | 0.18 | 185 | Same mixture used for all classes of castings. |
| 3 | 1.60 | 0.50 | 0.25 | 0.11 | 0.70 | 2.45 | 3.15 | 25 | 40 | 35 | *32000* | 3200 | 0.14 | 229 | *1 inch x 1 inch x 15 inch used. This mixture used only for small castings. |
| 4 | 2.20 | 0.65 | 0.30 | 0.09 | 0.20 | 3.30 | 3.50 | 45 | 45 | 10 | 34000 | 3800 | 0.17 | .... | Same mixture used for all classes of castings. |
| 5 | 2.65 | 0.60 | 0.22 | 0.075 | 0.25 | 3.30 | 3.55 | 61.6 | 33.4 | 5 | .... | 2200 | 0.16 | 153 | Same mixture as used for crankcases. |
| 6 | 2.60 | 0.65 | 0.50 | 0.09 | 0.25 | 3.25 | 3.50 | 50 | 45 | 5 | 30000 | 3000 | 0.12 | 192 | |
| 7 | 2.10 | 0.60 | 0.34 | 0.08 | .... | .... | .... | 50 | 30 | 20 | 26000 | 2800 | .... | 170 | |
| 8 | 2.40 | 0.60 | 0.50 | 0.09 | 0.35 | 3.10 | 3.45 | 56.25 | 6.25 | 37.50 | 21700 | 2800 | 0.12 | 170 | Same mixture as used for crankcases and flywheels. |
| 9 | 2.50 | 0.60 | 0.30 | 0.09 | 0.25 | 3.15 | 3.40 | 56.5 | 41.3 | 2.2 | 24000 | 2450 | 0.16 | .... | |
| 10 | 2.10 | 0.60 | 0.20 | 0.095 | 0.60 | .... | .... | 56 | 32 | 12 | .... | .... | .... | 190 | Same mixture used for all classes of castings. |
| 11 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | No data given on any class except cylinders. |
| 12 | 2.50 | 0.60 | 0.25 | 0.065 | 0.40 | 3.20 | 3.60 | 38 | 53 | 8 | .... | .... | .... | 145 | |
| 13 | 2.40 | 0.65 | 0.30 | 0.095 | 0.35 | 2.95 | 3.30 | 40 | 44 | 16 | .... | .... | .... | 165 | Same mixture used for all classes of work except cylinders. |
| 14 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | No data given on any class except cylinders. |
| 15 | 2.60 | 0.55 | 0.37 | 0.10 | 0.30 | 3.05 | 3.35 | 40 | 50 | 10 | 25500 | 2600 | 0.15 | 170 | |
| 16 | 2.65 | 0.60 | 0.22 | 0.09 | 0.45 | 3.15 | 3.60 | 43.3 | 51.7 | 5 | 22000 | 2400 | 0.125 | 174 | |

chucks holding the piston from the inside and causing considerable strain on the casting. It is well to toughen the iron by the use of a fair percentage of charcoal iron in the mixture, say about 20 per cent. For especially high grade pistons, where expense is not of prime importance, from 4 to 5 per cent nickel may be used to advantage. This gives an extremely fine grained metal with about 37,000 to 38,000 pounds per square inch tensile strength of uniform hardness, and having a beautiful finish when machined.

It is good practice, after the rough cut in the machine shop, to anneal pistons sufficiently to remove casting strains. This to a large extent prevents the castings from going out of round on the final operations.

An analysis of the data on small castings, given in Table III, reveals a range from a low silicon, hard iron in No. 3 to soft, rather high silicon irons such as Nos. 12 or 15, with the latter in a predominating majority. No. 3 stands out really as an exception to the usual run of irons for this class of work. It is interesting to note here, as a further instance of the effect of steel on the total carbon, a comparison with No. 8. Both contain approximately the same amount of steel in the formula, but a noticeable difference in the carbon percentages. No. 3 is melted in a 36-inch cupola with 2200 pounds of coke on the bed. The fuel ratios are not greatly different, No. 3 being 1 to 6.6 and No. 8 being 1 to 7.6. It would seem that No. 3 is melted lower than No. 8, which accounts to some extent for the difference in the carbon. As a rule castings in this class are not as complicated and variable in section as are cylinders and crankcases, and strength is not of primary importance. Therefore, they can stand being made softer and from a more fluid iron, with machining qualities given much more consideration. As said before, where possible, it is well to use the iron that gives the best results to the work at hand, and the composition and proportionment of the pig iron, remelt and steel is largely a matter of experience and judgment.

It is of interest to note that in No. 3 only 25 per cent of pig iron is used, which is the minimum in all the mixtures submitted. Oftentimes the ailments of defective castings are attributed to lack of sufficient pig iron in the mixture, but the writer is familiar with the foundry using this mixture, and the class of work turned out, and believes if it were not of proved value, it would not be submitted in the questionnaire. The experience of the writer has been that defects such as shrinks and draws have often been remedied by raising the percentage of pig iron when using less than 40 per cent pig iron, even though the analyses may be nearly identical in the two instances. For this class of work, the writer has used for a number of years a mixture of about the following composition:

| | Per cent |
|---|---|
| Silicon | 2.40- 2.60 |
| Manganese | 0.50- 0.70 |
| Phosphorus | 0.25- 0.35 |
| Sulphur | 0.06- 0.08 |
| Combined carbon | 0.30- 0.40 |
| Graphitic carbon | 3.10- 3.30 |
| Pig iron | about 40 |
| Remelt | about 50-52 |
| Steel | about 8-10 |

Little is given to comment on in the data on crank cases in Table IV. Most of the foundries use either the cylinder iron or the softer iron used for small castings. None use special iron for flywheels, but in most cases, use cylinder mixtures, especially where teeth are cut in the rim of the flywheels. The cupola practice is practically in every case a facsimile of that shown with the cylinder data.

To show the interest which some of the foundries manifested in data requested on the questionnaire, one large automobile corporation foundry submitted the ideal mixtures as viewed by their metallurgist, foundry superintendent and assistant foundry superintendent. This data is all available for use should the association desire to appoint a committee to draft recommendations for the different classes of this work to serve the automotive engineer and manufacturer as a guide in writing specifications.

**TABLE IV—DATA ON IRON FOR CRANKCASES**

| Number | Silicon | Manganese | Phosphorus | Sulphur | C. Carbon | G. Carbon | Total Carbon | Pig Iron | Remelt | Steel | Tensile Strength, pounds per sq. in. | Transverse Breaking Load, 1¼-inch diameter bar, 12-inch centers | Deflection, inches | Brinell Hardness | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Per Cent | | | | | | | | | | | | | | |
| 1 | 2.30 | 0.60 | 0.40 | 0.08 | 0.40 | 2.80 | 3.20 | 40 | 60 | | | | | | Same mixture as used for crankcases. |
| 2 | 2.50 | 0.60 | 0.55 | 0.15 | 0.45 | 3.10 | 3.55 | 35 | 40 | 25 | 40000 | 3100 | 0.18 | 185 | Same mixture used for all classes. |
| 3 | 2.25 | 0.65 | 0.20 | 0.10 | 0.40 | 3.00 | 3.40 | 34.3 | 45.7 | 20 | 30000 | 2000 | 0.15 | 201 | Same mixture used for cylinders and flywheels. |
| 4 | 2.20 | 0.65 | 0.30 | 0.09 | 0.20 | 3.30 | 3.50 | 45 | 45 | 10 | 34000 | 3800 | 0.17 | | Same mixture used for all classes. |
| 5 | 2.65 | 0.60 | 0.22 | 0.075 | 0.25 | 3.30 | 3.55 | 61.6 | 33.4 | 5 | | 2200 | 0.14 | 174 | Same mixture as used for miscellaneous class. |
| 6 | 2.20 | 0.65 | 0.45 | 0.09 | 0.50 | 2.00 | 3.40 | 50 | 37.5 | 12.5 | 33000 | 3300 | 0.12 | 217 | Same as for cylinders. |
| 7 | 1.75 | 0.55 | 0.25 | 0.08 | | | | 50 | 30 | 20 | 33500 | 3350 | 0.16 | 207 | Same as for cylinders. |
| 8 | 2.40 | 0.60 | 0.60 | 0.09 | 0.35 | 3.10 | 3.45 | 56.25 | 6.25 | 37.5 | 21700 | 2800 | 0.12 | 170 | Same mixture used on flywheels and miscellaneous class. |
| 9 | | | | | | | | | | | | | | | No data given. |
| 10 | 2.10 | 0.60 | 0.20 | 0.095 | 0.60 | | | 56 | 32 | 12 | | | | 190 | Same mixture used for all classes. |
| 11 | | | | | | | | | | | | | | | No data given. |
| 12 | 2.50 | 0.65 | 0.40 | 0.08 | 0.35 | 3.00 | 3.35 | 50 | 50 | | 27000 | 2720 | 0.10 | 180 | Same as used for miscellaneous class. |
| 13 | 2.40 | 0.65 | 0.30 | 0.095 | 0.35 | 2.95 | 3.20 | 40 | 44 | 16 | | | | 165 | Same as used for pistons and miscellaneous class. |
| 14 | | | | | | | | | | | | | | | No data given. |
| 15 | | | | | | | | | | | | | | | No data given. |
| 16 | 2.35 | 0.60 | 0.18 | 0.09 | 0.55 | 2.95 | 3.50 | 43.3 | 46.7 | 10 | 28000 | 3400 | 0.187 | 196 | Same mixture as used for pistons and miscellaneous class. |

## Buys West Allis Shop

A. M. Jones of A. M. Jones & Co., manufacturers of foundry equipment and for some time sales manager of the Federal Malleable Co., West Allis, has bought the plant of the West Allis Foundry Co., Seventy-fifth avenue and Elm street, West Allis, Wis. He will continue the manufacture of gray iron and semisteel castings and the organization operating the foundry will be continued without change.

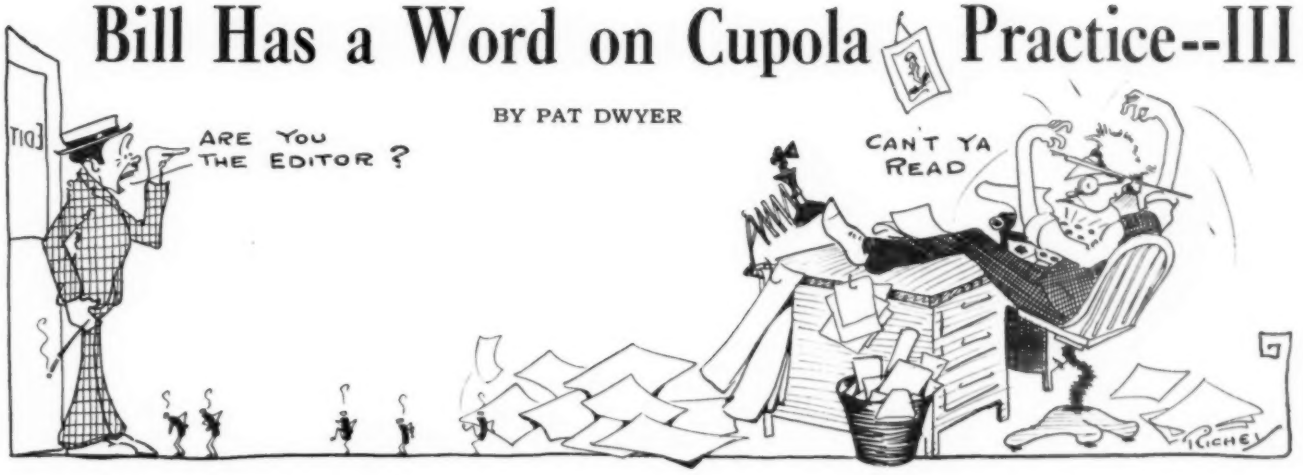
## Elect New Officers

At a recent meeting of the Springfield Malleable Iron Foundry, Springfield, Mass., the following officers were elected: H. P. Blumenauer, president, George T. Dewey, treasurer, William H. Gates, clerk. Alterations and extensions at the newly acquired property are now underway, and production of both aluminum and malleable castings is expected to start soon. About 20 per cent of the capacity of the plant will be devoted to aluminum work and the remainder to malleable.

Avoid accidents by guarding against excess moisture on all cement and metal plate surfaces.

# Bill Has a Word on Cupola Practice--III

BY PAT DWYER



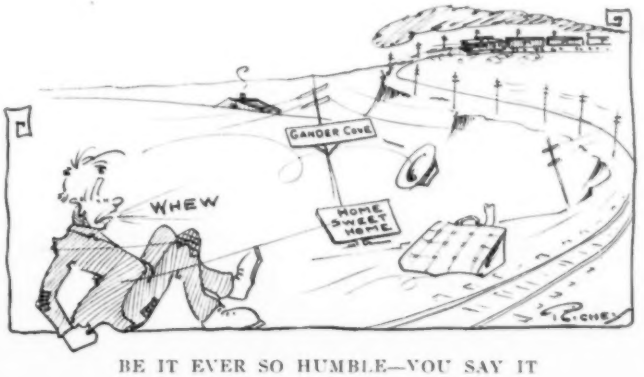

FOR the sake of auld lang syne I have subscribed for many years to a weekly newspaper published in a little town down east where my one and only living wife spent a few of her childhood years. She has not lived there for 40—Oh! well, the exact number of years really does not matter, but between ourselves it has been quite a few. After we set up housekeeping, planted the little vine and fig tree and all that kind of thing, you know, we lived in a neighboring town for several years. The vine and fig tree in this instance purely is a figment of the imagination for all this happened in a part of His Most Gracious Majesty's oversea Dominions where plants of that character would have as much chance of flourishing as an orchid in an Eskimo igloo. I never have been in an igloo, but you get my meaning.

The paper presents news and gossip from over all that general geographical section of the country and for that reason the contents possess a certain element of interest. News of the world is touched upon in a general manner common to newspapers everywhere the A. P. service is available. The editor wields a facile, trenchant and ubiquitous pen practically all over the front page and flays the everlasting hide off those connected with issues national, political or religious that do not meet with his approval. I have no idea how he is paid or whether like a true artist he works merely for pleasure, but if his remuneration is based on a space rate he must enjoy a princely income. The greater part of one of the inside pages is devoted usually to a violent discussion between two eminent citizens on some controversial subject in which each writer proves his contention conclusively by quotations from his own favorite history. The discussion always is prefaced by an editorial note to the effect that while the paper is willing at all times to throw its columns open to discussion of live topics and questions affecting the welfare of the community, it does not necessarily endorse the views set forth by the contributors. The discussion usually runs through several issues and then is chopped off for lack of space.

I have not the pleasure of the editor's personal acquaintance and never have seen him, but it requires no violent effort of the imagination to see him with his feet cocked up on the desk and with a satiricial grin illuminating his wise old phiz the while he edits the copy to a point that will let him out in the event of a libel suit.

Special correspondents contribute a column more or less from each of their respective centers and we learn for example that Dan McInnis the widow's son, is busy in the woods this winter getting out pit props for the Algonquin Coal Co. Hugh McGillvary, Red, recently has returned from the west. He went out on a harvest excursion last summer and after the close of the threshing season worked for some time in the northwest and in different places in the great republic to the south of us. Hughie says he is glad to return and declares in all his travels he has seen no place to equal Gander Cove. Andy Jamieson has been seen on several occasions recently in the vicinity of a certain house on the hill. We wonder what is the attraction? Attaboy Andy! The paragraphs vary to some extent, but they all have a family resemblance.

The obituary column occupies a prominent position in each issue. The various items are set appropriately in 8-pt black face and the lines separating the column from the columns on either side are twice the ordinary thickness. The notices are not arranged alphabetically according to the style of city newspapers where every agate line has a definite cash value where no person knows who's who—and does not want to know. No indeed. The paragraphs are arranged according to length, commencing with one of three or four lines setting forth that Joe Smith, a well known character around town for many years, passed away peacefully on the 28th ult., and concluding with a panegyric half a column in length covering the life and adventures of Jeremiah T. Jones, Esq., a sterling citizen whose place in the community will be hard to fill. No less than 42 autos and other vehicles besides a large and representative concourse on foot attended the funeral and attested to the respect and esteem in which he was held by people of all shades of religious and political opinion. (Canadian and American papers please copy.) I often have wondered in an idle manner what standard the editor employs in grading the notices and for want of any definite information on the subject have arrived at the conclusion that he probably consults his circulation list. Thus the extent of the notice would be based on whether the late lamented




BE IT EVER SO HUMBLE—YOU SAY IT

was in arrears, a paid in advance or a steady subscriber.

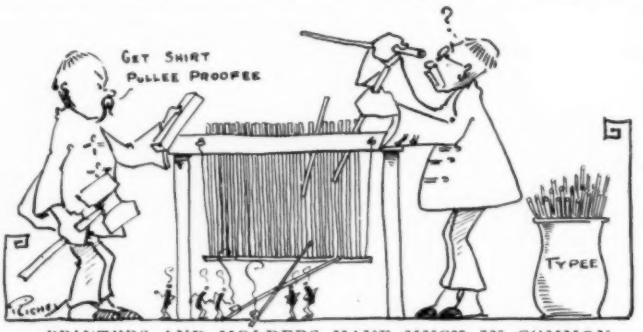
The statement frequently is made that the Chinese had newspapers 3000 or 4000 years B.C. Perhaps they had. One or two thousand years one way or the other really do not matter at this late date. In all probability even the most veteran editor is dead by this time and therefore we are in no immediate danger of provoking a controversy. Bret Harte is credited with a famous and widely quoted statement to the effect that for ways that are dark and for tricks that are vain the heathen Chinee is peculiar. Taking both these well known factors into consideration I think I am keeping well within conservative bounds when I say that the ways of a newspaper are beyond finding out. And that's that. If the ways of a newspaper man are peculiar, I must admit that the ways of the reader are more peculiar. That is if it is proper to say that one peculiar class is more peculiar than another. I am willing to let the grammarians fight over that point and content myself with the reflection that you probably know what I mean. For my part I read the paper methodically from the front page to the back. In fact the front page with is vitroilitic paragraphs interests me more than any other.

The lady for whom I buy the paper rarely looks at the front page. She turns the paper inside out and browses leisurely and contentedly first through the obituary column then through the column devoted to marriages and afterward through the local news. She seems to derive a certain amount of melancholy pleasure when she discovers a more or less familiar name among those who have gone to the haven under the hill.

The marriage announcements vary a trifle from time to time but follow a fairly well standardized formula in that the wedding was quiet but pretty; the presents were numerous and costly and the groom's present to the bride was a substantial cheque. Not check, but cheque.

I directed Bill's attention on one occasion to this practically obsolete manner of spelling and asked him if he could advance any explanation on why it is retained in this modern age when the tendency is all toward a system of spelling within the range of the average movie fan.

"Well" said Bill "I'll tell you. The simple Simon style of spelling is not a gage of the intelligence of the movie fans. I have made a rather intensive study of the subject in recent years and have arrived at the conclusion that the spelling rather reflects the mentality of the birds who write the captions.



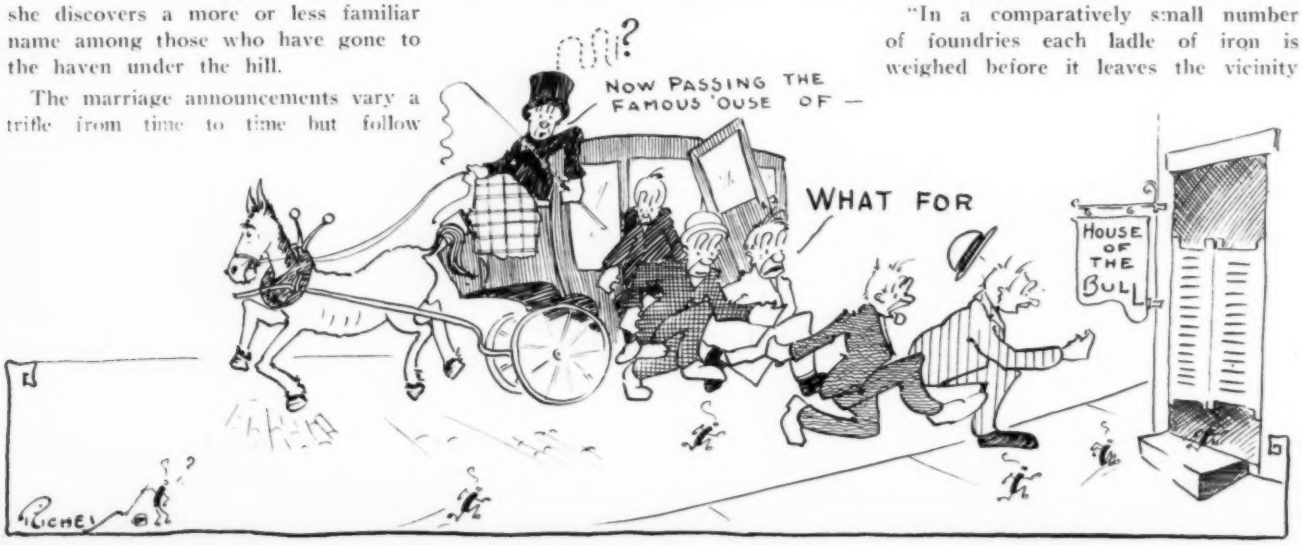
PRINTERS AND MOLDERS HAVE MUCH IN COMMON

"However, it is only wasted time discussing a subject in which I probably will find myself in a pitiful minority. Instead, if you have the time and the patience, I will take up a few more phases of the cupola question.

"Where a uniform product is made and the same mixture of iron used throughout the entire duration of the heat, a variation in the weight of the different charges due to carlessness in weighing methods will not affect the quality of the resulting castings. However, it will be reflected in the amount of iron left over or the number of molds left unpoured on the floor, depending on whether the charging men under loaded or over loaded their barrows or trucks. In either event the foreman bites his nails and begins to wonder if there is not something wrong with his method of figuring the heat and the superintendent begins to wonder if he had not better secure another foreman, one who can add two and two without making it come out three or five. One who can determine how much iron is required to pour off the floor.

You are familiar with the statement that eternal vigilance is the price of peace and certainly eternal vigilance is necessary in the foundry especially in these strenuous times if the foundryman expects to earn dividends on his investment. If careless charging methods are responsible for cupola trouble and extravagance when the same grade of iron is melted continuously throughout the duration of the heat, how much more are they liable to cause trouble and confusion when several different mixtures are poured on the same day. Even under the most favorable circumstances it is difficult at times to keep the charges separated and wherever practical it is customary to pour what is regarded as neutral iron into castings where the analysis is of no particular moment. This iron is tapped at a time when the foreman's calculation indicates that one grade of iron is all down and a second grade has commenced to melt.

"In a comparatively small number of foundries each ladle of iron is weighed before it leaves the vicinity



WORDS ARE SUBJECT TO MISCONCEPTION IN A LAND WHERE THERE'S NO 3-MILE LIMIT

of the cupola. In others the capacity of the ladle is known and it is only necessary to count the ladles as they leave, to determine the amount of iron melted. Knowing the total amount of iron charged and the order in which the various grades have been placed in the cupola and deducting the amount taken away at each tap, the foreman can keep an intelligent check on the progress of the heat. However, it will be noted that all subsequent calculations hinge on the supposition that a definite amount of iron has been placed in each charge and incidentally that the charges have been placed in the cupola in a certain designated sequence. If the premises on which the calculations are based are faulty, it is apparent that the calculations will be proportionally wide of the mark. .

"Small cupolas to be operated efficiently require more skilled supervision than large ones. Rough and ready methods to a certain extent may be employed on a large cupola without seriously impairing its efficiency, the rate of melting or the temperature of the iron. Unless the rules are followed rigidly in operating a small cupola it will melt erratically, the temperature of the iron will vary from time to time during the heat and, most common trouble of all, it will bridge across above the tuyeres and discontinue melting.

"In a general way small and large cupolas may be compared to small and large edge tools. Either one is satisfactory in the hands of a competent man. A big, broad bladed axe in the hands of a husky lumber jack may be employed with perfect propriety in felling trees. It may be claimed that it should be equally efficacious in cutting a man's nails, amputating an infected finger or in lancing a boil. I think that I am fairly safe in making the assertion that a surgeon would not care to use it for either of the purposes outlined. Even if he felt like trying the experiment it is probable that the patient would register the most violent species of protest.

"No particular difference exists between the operation of a blast furnace and a cupola. The raw material is charged at the top, a blast of air is applied to promote rapid combustion and the melted iron is tapped at the bottom and yet a blast furnace will run continuously for years, seven days a week, 24 hours a day and no person, least of all the furnace man, regard the performance as extraordinary.

"Contrast this with the average small cupola where if it is not handled carefully and intelligently it will choke inside of an hour. In fact not so long ago the belief was fairly universal among foundrymen that a cupola of any diameter inevitably would choke in a certain definite time. Even such a well known authority as the late Thomas D. West in his American Foundry Practice published first about 30 years ago, presents a table showing the relative melting capacity of various size cupolas. Not the melting capacity per hour, but the total amount that a cupola would melt at any one time before going out of commission. That idea has been fairly well disippated in recent years when foundrymen have found that a cupola irrespective of its size can be operated continuously all day.

"In fact the only limiting factor in connection with an attempt to operate it indefinitely is that the lining will burn through to such an extent that the shell is in danger. With a suitable water cooled lining similar to that on a blast furnace there is no reason why a cupola, if necessary, could not be kept in blast for an indefinite period.

"It may be interesting at this point to note that several years ago Edgar Allen Custer in conducting experimental work on a method for producing castings in permanent molds, melted iron continuously for a period of 49 hours in a 24-inch cupola. At the end of that time the cupola showed no sign of bridging, but the shell became so hot in the vicinity of the melting zone that it was considered advisable to drop the bottom and repair the lining. After the bottom was dropped a hose was turned on the lining to cool it off rapidly. The lining was repaired, the bottom made up, the cupola charged and iron once more was running from the spout in 7 hours. The cupola then was operated continuously for 47 hours before it again became necessary to make repairs.

"In the ordinary foundry, conditions similar to the foregoing do not obtain, at least to the extent of melting iron day and night, but in many places iron is melted continuously all day and no trouble is experienced either in securing this result or in keeping the lining in repair. Assuming that the bottom is dropped at 5 p.m., the furnace is allowed to cool until midnight. The night gang then repairs the lining, makes up the bottom, charges the cupola and has it ready to tap either at 7 a.m., or later if it is customary for the molders to start in on a clean floor. In some instances it is possible to provide a sufficient number of molds the preceding afternoon so that pouring can commence immediately in the morning.

"The old fashioned method and one that obtains to a considerable extent yet in many foundries, provides that all the molds made during the day shall be poured in one or two of the concluding hours in the afternoon. In the great majority of instances this is a time wasting method for it is customary for all the molders to quit molding when the wind goes on. It is apparent that no matter how fast the iron is melted all the floors cannot be poured simultaneously and many of the men are idle for varying periods of time waiting for their turn. In the interest of economy the work should by systemized to an extent that the molders should be continuously employed molding, while laborers at a comparatively lower wage should be employed to pour the iron and shake out the molds. Of course this division of labor cannot be applied in its entirety in all cases, but it can be adapted and modified to meet practically all conditions.

"The foundrymen are traditionally conservative and do not look with favor on changes and innovations. They are inclined to follow the line of least resistance. They may hear or read of improved practice in some other part of the country, but they are skeptical and rarely feel inclined to conduct a personal investigation to verify the report. There is nothing in Holy Writ to support the contention, but I always have felt that Tubal-Cain, patron saint of foundrymen, hailed originally from Missouri."

"Perhaps he did" I said "but I also am from Missouri and you'll have to show me."

"Do you know," said Bill "You should be ashamed to let your mind wander around in such a loose and irresponsible manner. You remind me of the story of the London omnibus. Passing through a certain district the guard announced: 'Lidies an' gents we are now pahsing one o' the most faimous and celebraited public 'ouses in the country, before he could continue with his oration a high pitched querulous American voice from the back seat was heard in one clear call 'WHAT FOR?' "

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An iron and steel exposition of power, mechanical, and electrical engineering will be held in the Buffalo auditorium, Buffalo, Sept. 24 to 25, under the auspices of the Association of Iron & Steel Electrical Engineers, Empire building, Pittsburgh.

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The Magee Furance Co., Boston, is installing machinery at the plant of the Gibby Foundry Co., Wakefield, Mass., to assemble complete hot water heaters.

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## Contents

| | Page |
|---|---|
| Cleveland Draws Large Crowd | 387 |
| New Developments Are Outlined | 391 |
| Industrial Education Topic | 393 |
| Sand Draws Enthusiasm | 394 |
| Cover Malleable Broadly | 395 |
| Steel Meetings Interest | 395 |
| Award Prize to Chill Car-Wheel Rig | 396 |
| Exhibition Covered Wide Range of Supplies and Equipment | 397 |
| President Summarizes Work | 403 |
| Displays Workmanship | 404 |
| Graphite Controls Gray Iron | 405 |
| Industry in Ceylon Found Depressed | 407 |
| Casting Art Bronze Tablets | 408 |
| How and Why in Brass Founding | 409 |
| Mixture for Nipples and Ferrules | 409 |
| Monel Metal Mixture | 409 |
| Combining Lead with Copper Alloys | 409 |
| Casting Heat Automatic Tools | 409 |
| Brass Key Alloy | 409 |
| Firm Develops Long-Life Mold | 410 |
| Uses Steel in an All-Scrap Mixture | 413 |
| Studies Automotive Castings | 414 |
| Buys West Allis Shop | 418 |
| Elect New Officers | 418 |
| Bill Has a Word on Cupola Practice—III | 419 |
| Gray Iron Questions Given Prominence | 422 |
| Trade Outlook in the Foundry Industry | 423 |
| Comings and Goings of Foundrymen | 424 |
| Founders Take a Whirl at the Royal Game | 424 |
| A. S. T. M. Convention Program Arranged | 425 |
| Detroit Supply Company Incorporated | 425 |
| Brass Foundryman Dies | 425 |
| Organize Core-Oil Producing Company | 425 |
| Club Well Represented at Convention | 425 |
| Scraper for Handling Loose Materials | 426 |
| Bolton Had Nugget | 426 |
| Builds New Plant | 426 |
| Manufactures Heavy Duty Scales for Cranes | 426 |
| Boring Cans Loaded by Improved Method | 426 |
| Recover from Loss | 426 |
| Will Enlarge Plant | 426 |
| Exhibition Makes Market | 427 |
| What the Foundries Are Doing | 428 |

## Gray Iron Questions Prominent

UNQUESTIONABLY gray iron is the metal of most interest to those who attend the conventions of the American Foundrymen's association, both on account of the great number of foundries making gray iron castings and because so many foundrymen who have not had theoretical metallurgical trainig as well as many who have studied the metal from laboratory standpoint are willing to discuss the different questions brought out by the papers. Unfortunately, this year, gray iron did not have as prominent a place on the program as it usually is given. However, in the short session on gray iron Thursday morning a number of important subjects in connection with this important metal were discussed.

In the early days of chemical analysis, silicon was the chief element considered and was almost entirely depended upon to control the physical properties of the metal. Gradually other elements came into more prominence and the effects of manganese, sulphur, phosphorus, and combined carbon were defined. It was not until recently that the question of total carbon was given place in the discussions on gray iron. Possibly this was due to the difficulty of controlling the amount of carbon taken up by the metal. This is stated to be true especially when steel is added to the mixture as then the melted metal is not near its saturation point in carbon. However, when pig iron and gray-iron scrap make up the entire charge, the effect of a high coke bed is less marked.

The second reason for carbon variation in the cast iron, as brought out at the meeting, is the quality of the coke. It was emphasized that the structure of the coke will determine to a great degree the amount of carbon taken up by the iron as it melts and falls through the white hot bed. Not enough is known about the effects of the different grades of coke to state definitely the effect of any certain grade, but it was thought by several of the speakers that an iron melted with a soft coke will absorb more carbon than when melted with a hard coke. The temperature and time of coking as well as the grade of coal from which the coke is made were said to be determining factors in its influence on the iron.

The progress report on the international test bar is of great interest as it indicates the likelihood of the adoption of such a bar by several countries interested in export trade. While the proposed bar differs slightly from that used in this country, as well as from the bars used in other iron producing countries, it was brought out that the adoption of a standard international bar would not need to interfere with the use of any bar any nation may prefer to use in its local work but would apply only in foreign commerce and would give a common basis for comparison between the different producing countries. The bar which is proposed is 18 inches long and marks a compromise between the 12-inch American bar and the 24-inch British bar. It has the decided advantage of giving a deflection which can be more easily determined than can the low deflection of the shorter bar. Its disadvantage is a 50 per cent increase in the amount of metal required.

# Trade Outlook in the Foundry Industry

ACTIVITY characterizes practically every line of manufacturing endeavor and the foundry industry is in the forefront of the present wave of high speed production. The output of castings is limited only by the ability to secure sufficient men, as orders are plentiful. The malleable foundries are operating at 75 per cent of capacity or better, which is in excess of the rate of production prior to the 1920 slump. Gray iron jobbing shops are working full time and while steel foundries, in general report the highest production in years.

**Labor Still Problem**

While the labor shortage still obtains in the foundry industry in general, no further curtailment in the available supply is expected. Building construction is now in full swing, the drift of workmen to the larger centers is easing the situation in some quarters, and above all, the output per man is greater than during the war and the period immediately following. Secretary Hoover states that the efficiency of production has been increased from 10 to 15 per cent per capita since the period immediately preceding the war, and naturally this is much better than that which obtained during the boom years that followed the war. Foundry capacity is greater than it has been at any previous time, but the demand which has been built up by the increased consumption of all classes of commodities seems to engage all the output which the foundries are capable of delivering. The period of plant expansion which accompanied the past era of activity is absent. Many large institutions, profiting by their previous experience during the dark days of 1920 and those which followed, are abstaining from the temptation to build and equip their own foundries, and rely instead upon jobbing interests to meet their excess casting needs. This is particularly true in the automotive lines.

**Prices of Raw Material for Foundry Use**

CORRECTED TO MAY 10

| Iron | | Scrap | |
|---|---|---|---|
| No. 2 Foundry, Valley.... | $31.00 | Heavy melting steel, valley. | $24.50 to 25.00 |
| No. 2 Southern, Birmingham | 27.00 to 28.00 | Heavy melting steel, Pitts.. | 22.50 to 23.00 |
| No. Foundry, Chicago.... | 32.00 to 33.00 | Heavy melting steel, Chicago | 20.75 to 21.25 |
| No. 2 Foundry, Philadelphia | 31.76 to 33.13 | Stove plate, Chicago..... | 20.25 to 20.75 |
| No. 2 Foundry, Buffalo.. | 29.50 to 30.50 | No. 1 cast, Chicago..... | 26.50 to 27.00 |
| Basic, Valley ..... | 31.00 | No. 1 cast, Philadelphia.... | 22.00 to 23.00 |
| Basic, Buffalo..... | 30.50 | No. 1 cast, Birmingham... | 23.00 to 24.00 |
| Malleable, Chicago ..... | 32.00 to 33.00 | No. 1 cast, Buffalo..... | 25.50 to 26.50 |
| Malleable, Buffalo..... | 30.00 | Car wheels, iron, Chicago.. | 25.00 to 25.50 |
| **Coke** | | Railroad malleable, Chicago. | 26.00 to 26.50 |
| Connellsville foundry, coke.. | $6.50 to 7.50 | Agricultural mal., Chicago.. | 24.50 to 25.00 |
| Wise county foundry, coke.. | 8.00 to 8.50 | Malleable, Buffalo ..... | 27.50 to 28.50 |

**Activity Widespread**

Perhaps the most encouraging feature of the present prosperous period is the fact that all lines of industry alike seem to be quickened. The buying movement has set in strongly in all channels, yet the demand is restrained within reason. A jobbing steel foundry reports orders to fill its plant to capacity for about 30 days ahead, and inquiries develop each week to maintain about the same backlog. Stovemakers encounter the same situation. Buyers are not anticipating far in advance on their requirements, nor do they court over stocking in any commodity. Demand from the farming interests has been the last to awake, but at present the implement and tractor industry is working well over 70 per cent of capacity. One company making farm machinery received in one month's time more inquiries than had been its portion for the preceding two years. Prices on implements and tractors are being advanced and some difficulty is reported on the part of manufacturers due to shortage and slow delivery on steel. A large radiator interest has instructed salesmen to accept no orders for delivery prior to July 1, as its entire output is engaged up to that date. Prices are being advanced until radiation now is about 25 per cent higher than it was a year ago.

**Sets New Record**

Pig iron output for April established a new record, according to statistics compiled by *The Iron Trade Review*. The total production recorded was 3,547,012 tons, which compared with March's total of 3,523,595 tons gives a gain, even though the past month was one day shorter. The daily average production for April was at the rate of 118,233 tons, which outstrips the previous record of 113,774 tons, made in September, 1918, by 4459 tons per day. The record was established solely on high rate production for only 310 blast furnaces were in operation on the last day of April, compared to 371 in August, 1918, when the greatest number ever reporting was recorded. The total output of merchant iron during the past month was 787,796 tons, giving an increase of 20,577 tons over the previous month. On a daily average basis, April showed 26,260 tons per day or a gain of 1511 tons over March's figure of 24,749 tons per day. Pig iron prices remain practically stationery, although some resales of small tonnages are reported at a slight reduction. Deliveries of both iron and coke are fair, although the railroads are pushed to capacity at the present time. A high record in car loadings was noted during the week of April 21, when the total soared to 957,743 cars. In the week of April 14 946,759 carloads were reported. In the same week last year, the figure was 700,155 cars and in 1921, 702,116 cars. Railway purchases of equipment have slowed down, chiefly due, it is stated, to the inability of manufacturers to complete more orders. Preliminary figures for April show a total of 9500 car awards and 100 locomotives.

**Nonferrous Prices**

Prices for nonferrous metals, based on New York quotations in *The Daily Metal Trade* of May 10, follow: Casting copper, 16.00c; electrolytic copper, 16.00c to 16.12½c; Straits tin, 43.75c to 44.00c; lead, 7.25c; antimony, 7.62½c; aluminum, No. 12 alloy, open market, 23.00c to 25.00c. Zinc is 6.75c to 7.00c. Average prices on nonferrous metals for April follow:

(New York Quotations)

| Casting Copper | Electro Copper | Lead | Tin Straits | Antimony | Aluminum 98-99 | Zinc St. Louis |
|---|---|---|---|---|---|---|
| 16.64 | 17.06 | 8.20 | 45.89 | 8.42 | 26.50 | 7.32 |

# Comings and Goings of Foundrymen

OLIVER W. LOOMIS, formerly manager of sales of the National Malleable Castings Co., Cleveland has been transferred to Chicago where he has been placed in charge of the company's largest manufacturing group, as manager of the three plants located in that city. Mr. Loomis started his career with the company on March 1, 1891, as shipping clerk, and rose through various positions in the office until he became cashier of the Cleveland works. He was then transferred to the manufacturing department and later to the sales department where he was placed in charge of the railway sales and finally became manager of sales, including both railway and miscellaneous sales.

Leonard Box is now foundry manager of the Excelsior Tool & Machine Co., East St. Louis, Ill.

W. C. Speiser has accepted a position as general foreman of the Doylestown Agricultural Co., Doylestown, Pa.

James A. Slater has been made manager of sales of the National Malleable Castings Co., Cleveland, succeeding O. W. Loomis.

C. A. Rose has been appointed general manager of the British American Nickel Corp., Ltd., with offices in Ottawa, Canada.

Robert T. Barnett, formerly with the Beaumont Iron Works Co., Beaumont, Texas, is now efficiency man with the Michigan Steel Casting Co., Detroit.

Charles W. Erkert of the general accounting department, National Malleable Castings Co., Cleveland, was made cashier of the Toledo works, succeeding George A. Logan, resigned.

Samuel Ferguson, secretary of the Connecticut Electric Steel Co., Inc., Hartford, Conn., has been elected president of the New England section of the National electric light association.

L. R. LeMoine, for many years president of the United States Cast Iron Pipe & Foundry Co. has been elected chairman of that company. N. F. S. Russell was elected president to succeed Mr. LeMoine.

Henry F. Thorpe has resigned as purchasing agent of the Dean works, Holyoke, Mass., of the Worthington Pump & Machinery Corp., to engage in business in that city as commission broker in metals and raw materials.

O. J. Fehling, manager of the Chicago plant of the National Malleable Castings Co., has resigned to retire from business activity. Starting with the company as an office boy in 1884, Mr. Fehling progressed to the position of works director in Oct. 1905, and

OLIVER W. LOOMIS

manager seven years later. A farewell banquet was tendered him at the La-Salle hotel, Chicago, by his associates.

E. C. Jarvis, formerly superintendent, the McNab & Harlin Mfg. Co., has accepted the position as vice president and general manager of the Niagara Falls Smelting & Refining Co., Buffalo, N. Y.

C. T. Lonney, local treasurer of the Cleveland works of the National Malleable Castings Co., was transferred to the treasurer's department, general offices, Cleveland, for special work. Robert A. Benson was made treasurer of the Cleveland works, succeeding Mr. Lonney.

Emil Ramas, president of the Association Technique de Fondrie de France, sailed for France on the liner Lafayette from New York, May 12. Mr. Ramas came to America to officially extend an invitation from the French association to the members of the American Foundrymen's association, at the Cleveland convention, to attend the International foundrymen's covention to be held in Paris in September.

## Founders Take a Whirl at the Royal Game

George B. Pickop, Malleable Iron Fittings Co., undisputed golf champion of Branford, Conn., easily walked away with the silver mounted bag donated as a trophy at the recent blind-handicap, golf tournament staged in connection with the convention of the American Foundrymen's convention in Cleveland. George modestly admits that plain luck may be slightly responsible for his success, but he is inclined to ascribe his victory principally to his superior skill with the niblick and other tools and also to the manner in which he planned and carried out his campaign.

For the benefit of foundrymen not yet addicted to golf, it may be stated that a blind handicap is designed to place every player on an equal footing. A disinterested person marks a secret number on the score card. The number then is covered and the contestants are advised that it lies between certain limits. Each man knowing his own limitations is allowed to name his own handicap. After the players have gone over the course, each man's score is totaled, his handicap deducted, the secret number is exposed and the man whose net score most nearly approaches the exposed number, is declared winner.

For example, in the present instance the secret number was 77, the winner's total score was 98, his handicap was 20 and his net score was 78. F. F. Griswold and O. H. Theleen, Cleveland, runners up, received prizes of six golf balls each and B. R. Pearce, Atlas Foundry Co., Cleveland with a low medal score of 86 was awarded a prize of 12 golf balls.

## Consider Refractories

The division of simplified practice of the department of commerce is arranging for a meeting in Washington, May 21 to consider standardization of refractories used in foundries. At this meeting, which has been requested by the American Foundrymen's association, a committee will be named to make a preliminary survey.

## A. S. T. M. Convention Program Arranged

The tentative program for the convention of the American Society for Testing Materials to be held at the Chalfonte-Hadden Hall, Atlantic City, June 25 to 29, indicates that the meetings up to Wednesday noon will be devoted to the metals while the following meetings will cover the various other phases of work taken up by the society. The endurance of metals under repeated stresses is discussed in two papers, one devoted primarily to steel and the other to duralumin and manganese bronze. The work of the U. S. bureau of standards in the study of gases in steel is to be described, and a discussion of the desirability of including chemical requirements in cast-iron specifications has been arranged. A further report on the effect of phosphorus and sulphur in steel will be presented by the joint committee on that subject. The following program has been arranged tentatively covering the iron and steel sessions:

**Monday, June 25, 8 p.m.**

Report of Committee B-1, on Copper Wire; J. A. Capp, Chairman.
Report of Committee B-2, on Nonferrous Metals and Alloys; William Campbell, Chairman.
Method of Casting Test Specimens of Gun Metal, by E. H. Dix, Jr.
The Influence of the Ratio of Length to Diameter in Compression Testing of Babbitt Metals, by J. R. Freeman, Jr.
Report of Committee E-4, on Screen Wire Cloth; R. W. Woodward, Chairman.
Report of Committee E-4, on Metallography; W. H. Bassett, Chairman.
Announcement of the Election of Officers.

**Tuesday, June 26, 9:30 p.m.**

Report of Committee A-5, on Corrosion of Iron and Steel; J. H. Gibbony, Chairman.
Report of Committee B-3, on Corrosion of Nonferrous Metals and Alloys; E. C. Lathrop, Chairman.
Endurance Properties of Steel, by D. J. McAdam, Jr.
Resistance of Manganese Bronze, Duralumin and Electron Metal to Alternating Stresses, by R. R. Moore.
Report of Committee A-8, on Magnetic Analysis; F. P. Fahy, Chairman.
A New Method of Magnetic Inspection, by A. V. deForest.
Report of Committee A-6, on Magnetic Properties; C. W. Burrows, Chairman.

**Tuesday, June 26, 3 p.m.**

Report of Committee A-2, on Wrought Iron; H. E. Smith, Chairman.
Report of Committee A-3 on Cast Iron; Richard Moldenke, Chairman.
Topical Discussion: "Is It Desirable to Include Chemical Requirements in Cast Iron Specifications?" Affirmative, Robert Job; Negative, Richard Moldenke.
Report of Committee D-5, on Coal and Coke; A. C. Fieldner, Chairman.
Properties of Metallurgical Coke, by G. St. J. Perrott and A. C. Fieldner.
The Significance of Tool Temperature as a Function of the Cutting.
Resistance of Metals, by A. H. Schwartz and W. W. Flagle.
Report of Committee A-4, on Heat Treatment of Iron and Steel; H. M. Boylston, Chairman.

**Tuesday, June 26, 8:30 p.m.**

Annual Address of the President; George K. Burgess; Followed by Informal Dance and Smoker.

**Wednesday, June 27, 9:30 a.m.**

Annual Report of the Executive Committee, by C. L. Warwick, Secretary-Treasurer.
The relation of the American Society for Testing Materials to Research in Engineering Materials, by George K. Burgess, President.
Report of Committee E-6, on Papers and Publications; C. L. Warwick, Chairman.
Report of Committee A-1, on Steel; F. M. Waring, Chairman.
Gases in Metals, by Louis Jordon.
Report of the Joint Committee on Investigation of Phosphorus and Sulphur in Steel.
Report of Committee E-1, on Methods of Testing; J. A. Capp, Chairman.
New Developments in Telemetric Devices, by O. S. Peters and R. S. Johnson.
Optical Strain Gages and Extensometers, by L. B. Tuckerman.

## Detroit Supply Company Incorporated

The Frederic B. Stevens company was at the exhibit of the American Foundrymen's association as an incorporated company for the first time this year, under the name of Frederic B. Stevens, Inc. Having been in the foundry supply business for 35 years Mr. Stevens has built up a large clientele and a well balanced organization, a large number of the members of which have been associated with him for many years. The object of incorporation was to bind closer together this organization which includes, besides the parent house in Detroit, branch houses which are maintained in the larger cities.

## Cost System Coming

A SERIES of six articles detailing a foundry cost system in successful operation in iron foundries will be started in the June 1 issue of THE FOUNDRY. Endeavor has been made at various times to secure a cost article fully meeting the needs of the foundry. Two essentials have been studied in accepting this series, FOUNDRY COSTS SIMPLIFIED, for publication. The need of accuracy is realized. This is found in nearly all cost systems, but few of them are elemental in character and either are too cumbersome to use or require an expert accountant to install them. In the articles to be published it is the endeavor of the author, Arthur Baruch, to make the system as simple as possible consistent with accuracy and to eliminate all superfine hair splitting costing. In fact, the whole object is to put forth a practical system, explaining it as clearly as possible and illustrating it with the forms to be used so that the reader may understand it more readily. The first article gives definitions of cost terms and furnishes the reader with a clear comprehension of the foundation of the system. Watch for it.

## Brass Foundryman Dies

Jacob G. Kasjen, prominent brass foundryman and lifelong resident of Peoria, Ill., died in his home in that city, Friday, April 13 at the age of 53 after an illness of two months. He was born in Peoria, Aug. 1, 1870, son of Jacob and Martha Kasjens, pioneer residents of the city. In his youth he learned the steam fitting trade with the firm of Klingle Bros., and in 1895 became associated with E. B. Hazen and the late Arthur T. Ancliffe in the Brass Foundry & Heating Co. Eventually, he became president of the Brass Foundry & Heating Co., and also served as vice president of the Kasjens Plumbing Co., in which he was associated with his brother Theodore. Mr. Kasjens was married to Mary Wilton April 4, 1894. He is survived by his widow and two children, one son, Karl J. Kasjens, and one daughter, the wife of Dr. Clarke E. Chamberlain.

## Organize Core Oil Producing Company

The Michigan Core Oil Co., 42 Victoria street, River Rouge, Mich., has been organized recently by A. P. Jones, formerly with the May, Maier & Jones Co. of Ecorse, Mich., and M. M. Wereckman, of Dayton, Ohio. Mr. Jones has had long experience in the manufacturing business, especially core oil, and Mr. Wereckman likewise has had practical experience, having been a foundryman and also for the past few years a salesman for the E. J. Woodison Co., Detroit. This company will manufacture and market a high grade core oil.

## Club Well Represented at Convention

The Chicago Foundrymen's club, one of the oldest organizations of the kind in the country, was well represented at the convention and exhibit, no less than two past presidents, Eugene W. Smith and C. E. McArthur; A. W. Gregg, vice president of the club, the Whiting Corp., Harvey, Ill.; and the secretary, George H. Manlove of THE FOUNDRY, being there. There were also a number of members, among them George A. T. Long, Pickands, Brown & Co., and the Semet Solvay Co.; H. S. Simpson, National Engineering Co.; J. H. Hopp, Charles C. Kawin Co.; and W. M. Wilson, C. E. McArthur & Co., all of Chicago.

## Scraper For Handling Loose Materials

The Link Belt Co., Philadelphia, is manufacturing a power hoe advertised as an improved drag scraper. Some of the advantages claimed for it are: it is applicable to large or irregular shaped storage, suitable for storing either in buildings or out of doors, obtainable in sizes to meet the demand for any required storage area and capacity; cost of installation and operating is low, does not require skilled operators, any part of coal storage can be reached in case of fire. The power hoe or drag scraper equipment consists of the following principal parts: driving machinery and drums, lead and balanced sheaves, scraper and steel cable. The tool itself is a simple device having runners forming the sides for the scoop and serving as guides, and a top plate which prevents it from digging in too far and thus overloading the cable, motor or back posts.

## Bolton Had Nugget

To show that all is not gold that glitters, J. W. Bolton, Niles Tool Works Co., Hamilton, O., brought to the American Foundrymen's association convention a cast bar of soft open-grained iron. At one section this bar was machined and finished in the usual way showing the characteristics rough finished, while at another section a different machine-finish has been given the bar and it looked like a close grained semi-steel.

## Builds New Plant

The Niagara Falls Smelting & Refining Co., is building a new plant at Albany and Niagara streets, Buffalo, for the production of ingot metals and castings of special alloys. The plant which will have an initial capacity of 10 tons of castings a day will begin operations in about 2 months. W. R. Hopkins is president and E. G. Jarvis is vice president and general manager.

## Manufactures Heavy Duty Scales for Cranes

Much progress has been made in industrial lines in developing new uses for weighing devices and new scales which are particularly adapted to meet specific requirments. As an example for uses of weighing devices, the government bought a number of scales during the tests of the R-34 to measure the pull on the cables used to hold the airship to the moorings. For a number of years John Chatillon & Sons, New York, have been developing special scales, particularly heavy-duty scales to weigh or measure the pull of unusually heavy loads. The 10,000 pound scale shown in the accompanying illustration was developed for use on crane booms where the loads to be handled do not exceed 10,000 pounds. This measuring device assures the operator that the safe working load will not be exceeded, eliminating dangerous overloading and disastrous accidents This scale is of all steel construction. Its action depends on four heavy tested springs which are oil tempered after cooling. The dial is 15 inches in diameter and is plainly etched.

THIS SCALE WILL WEIGH CRANE LOADS UP TO 10,000 POUNDS

## Boring Cans Loaded By Improved Method

Something new in the method of utilizing chips and borings in the cupola was shown for the first time at the recent exhibition held in connection with the convention of the American Foundrymen's association. The container was developed by the Wheeling Corrugating Co., Wheeling, W. Va., and the device for packing the chips solidly was made by the Malleable Iron Fittings Co., Branford, Conn. The charging can is made of light gage black sheet steel. It is made in two diameters 6 and 7 inches, 24 inches long. It is provided with an open lock seam for the full length and is die cut at each end to form three lugs which are turned in after the can is loaded. These hold the end disks in place. The cans are shipped nested in a metal cask. It is claimed that they provide a convenient and economical means for handling a class of scrap usually regarded as waste. It also is stated that the sealed ends prevent oxidizing, decrease melting loss and excessive slag formation by holding the contents together until the entire mass fuses as a unit.

The Malleable Iron Fittings Co., has developed a loading stand to be used with the can. The upper side of the stand forms a suitable recess to hold the bottom of the can. A vibrator fitted to the under side of the stand shakes down the material as it is poured into the top of the can and it is claimed increases the weight of the can by from 10 to 20 per cent. This not only makes for more economical loading, but also decreases the chance of oxidation usually present where light material is melted.

## Recover From Loss

The recent fire which partly destroyed the pipe blacking and mineral facing mill of the Bloomsbury Graphite Co., Bloomsbury, N. J., was fortunately confined to one mill building only. The larger mill devoted to the manufacture of foundry facings was not damaged and production is being carried on to full capacity.

## Will Enlarge Plant

The Bridgeport Safety Emery Wheel Co., Bridgeport, Conn., plans to construct a modern machine shop for the manufacture of floor grinders. The company also will build and equip a modern plant for the manufacture of vitrified wheels.

# Exhibition Makes Market

## Cleveland Exhibition of Equipment and Supplies Offered Unusual Opportunity To Bring Together Manufacturer and Consumer— Inquiries Are Large

THE foundry equipment and supply exhibition which was held in Cleveland in connection with the convention of the American Foundrymen's association convention proved a profitable source of business to the machinery manufacturers present. Many orders were booked, inquiries were numerous and a great number of exhibitors were able to send the equipment which they displayed directly to consumers from the floor of the show. The Foundry Equipment Co., Cleveland, recently has sold core oven equipment to the following firms: Wolverine Brass Works, Grand Rapids, Mich., the Cleveland Brass Mfg. Co., Cleveland, and the Craig Foundry Co., Brooklyn. Messingwerk Schwarzwld, Villingen, Baden, Germany, is inquiring for electric furnaces for melting brass. The Niagara Falls Smelting & Refining Co., E. G. Jarvis, vice president and general manager, is constructing a new plant to make ingot metals at Albany and Niagara streets, Buffalo. Catalogs of foundry equipment are desired. The Ersted Machinery Co., Portland, Ore., will purchase equipment for a complete new shop to make 2000 automobile pistons per day. The Sanford Riley Stoker Co., Detroit, has purchased a crane for its foundry department from the Northern Engineering Works, Detroit. The University of Michigan, Ann Arbor, Mich., and the Semisteel Test Foundry, Chicago, have purchased cranes from the same maker. Recent purchasers of sand blast equipment from the Pangborn Corp., Hagerstown, Md., include the Connecticut Foundry Co., Rocky Hill, Conn.; the Singer Mfg. Co., Elizabethport, N. J.; the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.; the Oil Well Supply Co., Oil City, Pa.; the Perfection Heater Co., Cleveland; the Buick Motor Co., Flint, Mich.; the Superior Steel Castings Co., Cleveland; and the American Range & Foundry Co., Minneapolis. The Capital Castings Co., Lansing, Mich., has purchased a molding machine from the Arcade Mfg. Co., Freeport, Ill. The Buhl Malleable Co., Detroit, has purchased three rollover molding machines from the Osborne Mfg. Co., Cleveland, and two sand mixers from the National Engineering Co., Chicago. The Michigan Gray Iron Foundry, Detroit, has installed five jolt-strip squeezer machines made by the Wm. H. Nicholls Co., Brooklyn, N. Y.

### Small Orders Plentiful in the East

AN ACTIVE demand for foundry equipment continues, although with one or two exceptions, the individual orders have not been large. This latter is attributed principally to the fact that new foundry construction is rather restricted, although much new work, including a number of projects heretofore listed, is in prospect. Need for increased operations in conjunction with labor shortage is the principal cause underlying the present activity in buying. A good illustration of the demand for labor-saving equipment is to be found in sand-cutting machinery, manufacturers of which are now sold ahead on an average of four months. Good demand for conveying equipment also affords another excellent example. While business in this latter line has not reached the peak of 1920, orders are numerous. The past two months, in the experience of a number of crane builders, has been the most active in more than three years, and follow a period of four or five months in which demand improved substantially. Overhead crane builders are booked ahead on an average of three to four months. One of the largest overhead crane orders to be noted recently in the foundry field calls for seven 10-ton electric traveling cranes, with spans ranging from 51 to 95 feet, for the Hunt-Spiller Mfg. Co., Boston, this business going to the Whiting Corp., Harvey, Ill. This contract was referred to in the preceding issue as on the verge of being placed. Another Massachusetts buyer is the F. B. Smith Mfg. Co., Westfield, which closed on $5000 or $6000 worth of foundry equipment. The American Car & Foundry Co. has closed on a 10-ton electric crane, with 100-foot span, for its Chicago plant, to the Pawling & Harnischfeger Co., Milwaukee, and a 5-ton used electric crane, 47-foot span, for its Buffalo plant, to the Industrial Equipment Co., 149 Broadway, New York city. The American Car & Foundry Co. continues in the market for a 15-ton and a 5-ton electric crane, each with 60-foot span. A likely buyer of foundry equipment is the Reading Knob Works, Reading, Pa., which recently has completed plans for a $35,000 foundry addition. Prices for the most part are unchanged, although the tendency is strongly upward.

### Convention Influence Felt in Pittsburgh

FOUNDRY equipment sellers in the Pittsburgh area report that while it is rather early to gage the value in immediate sales of the recent foundrymen's convention and exhibition at Cleveland, they believe that in importance and scope it was second to none. Many of them now are getting in touch with prospects which were developed during the convention week. This is particularly true of some of the molding machine manufacturers, including the Herman Pneumatic Machine Co., which made no effort to sell equipment at the show, merely taking names of prospective buyers. It states that if 20 per cent of those develop into orders its plant will be working at capacity for many months to come. At present it is working 100 per cent night and day and is swamped with inquiries. Included in recent orders taken by the Herman company are the following: Two large rollover machines for the Toledo Machine & Tool Co., Toledo, O.; three for the Commonwealth Steel Co., Granite City, Ill.; and one each for the Ohio Steel Foundry Co., Lima, O., Flockhart Foundry Co., Newark, N. J., and the American Radiator Co. Sales of both iron and steel flasks, too, have been heavy of late in lots up to 125 flasks each. Additional sales of wheelbarrows and other similar equipment likewise are reported. Two or three inquiries are out for sand machinery of various sorts and one or two blowers are up for consideration. Interest of foundries in cranes continues to manifest itself from time to time. The Standard Steel Works Co., Burnham, Pa., recently

closed on a 10-ton 3-motor, and a 20-ton 4-motor overhead traveling cranes, both with 58-foot span, to the Milwaukee Electric Crane & Mfg. Co., Milwaukee. The Alliance Machine Co., Alliance, O., has sold a 25-ton crane to the Bethlehem Steel Co.

### Chicago District Profits by Show

CONTINUED activity of foundries in the Chicago district is reflected in heavy buying of equipment, from cranes and cupolas to ladles and trucks. Foundries apparently believe the present heavy demand for castings will continue and are equipping their plants to care for business in an efficient way. One of the interesting developments of the past few days has been the execution of a contract by the Grindle Fuel Equipment Co., a subsidiary of the Whiting Corp., Harvey, Ill., for a complete powdered fuel installation in the malleable plant of the Hunt-Spiller Mfg. Corp., Boston. This installation is to serve six furnaces and will cost in excess of $100,000. This is one of the largest powdered fuel installations in this country. The Hunt-Spiller Mfg. Corp. has also bought from the Whiting Corp. seven cranes for its Boston plant. The Davies & Thomas Co., Catasauqua, Pa., has bought a cupola; the Utica Heater Co., Utica, N. Y., a cupola and the American Radiator Co., two cupolas, all from the Whiting Corp. Demand for ladles continues heavy and as this class of equipment is in direct relation to the tonnage of iron melted, the outlook is promising.

# What the Foundries Are Doing

## Activities of the Gray Iron, Malleable, Steel and Brass Shops

The Schuessler Foundry Co., Alton, Ill., has started work on the erection of a foundry building.

The Jamestown Malleable Products Corp., Jamestown, N. Y., recently increased its capital stock from $500,000 to $1,000,000.

The Holland Foundry Co., Holland, Mich., is erecting an addition to its plant, 40 x 60 feet.

The Standard Sanitary Mfg. Co., Pittsburgh, plans the erection of two additions to its plant.

The Hunt-Spiller Mfg. Corp., Boston, iron founder, has had plans prepared for the erection of a 1-story plant building, 135 x 240 feet.

The Frank Foundries Corp., Moline, Ill., has started work on the construction of a plant addition to be built at an estimated cost of $20,000.

Part of the plant of the Twin City Brass & Aluminum Foundry Co., 815 Washington avenue, Minneapolis, recently was damaged by fire. It will be rebuilt.

Rice, Barton & Fales, Inc., Worcester, Mass., have let the contract for the erection of a 1-story foundry building, 36 x 140 feet, to be built at an estimated cost of $50,000.

W. G. Garvey, 4616 Bloomingdale avenue, Chicago, has let the contract for the erection of a 1-story foundry building, 63 x 73 feet, to be erected at an estimated cost of $6600.

The Reading Knob Works, Reading, Pa., is having plans prepared for the erection of a foundry extension to be built at an estimated cost of $35,000.

With a capital stock of $10,000 the Liberty Foundry Co., Liberty, Ind., recently was incorporated by Lorin M. Kennedy, John F. Rude and John E. Roughan.

The City Brass Foundry, Inc., Waltham, Mass., recently was incorporated with a capital stock of $20,000 by Clifford Belcher, Newton, Mass., Harold H. March, Needham, Mass., and Rodney G. Page, Watertown, Mass.

Contract has been awarded by the Mississippi Foundry & Machine Co., Jackson, Mich., to W. J. McGee, for the erection of a 1-story shop building, 60 x 165 feet, to be built at an estimated cost of $35,000.

The Heating Range Mfg. Co., 4716 Fairmont avenue, Kansas City, Mo., plans the erection of a 1-story foundry and machine shop, 100 x 150 feet, to be built at an estimated cost of $35,000.

The National Furnace & Foundry Co., Ltd., Beaverton, Ont., has been incorporated to manufacture furnaces, stoves, etc., with $100,000 capital stock by George M. Huycke, Norman E. Strickland, George E. Atwood and others.

With $500 capital stock the Osborn Piston Ring Co., Cleveland, recently was incorporated by William A. McAfee, East Ohio Gas building, C. A. Niman, W. T. Holliday, Maurice F. Hanning and Leonard Smith.

The Windsor Piston Ring Co., Ltd., Windsor, Ont., has been incorporated to manufacture piston rings, etc., with $40,000 capital stock, by Harry McGhee, Max Grabowsky, both of Detroit; James L. Reaume of Windsor, and others.

The United States Foundries & Mfg. Co., East Chicago, Ind., has been incorporated with a capital stock of $50,000, under the laws of Delaware. Incorporators are James E. Nellis, Dollie R. Sambursky and Alexander Vitkus. The company is represented by the Delaware Registration Trust Co.

Capitalized at $225,000, the Wisconsin Steel Casting Co., Milwaukee, recently was incorporated to conduct a steel foundry business. Waldemar C. Wehe, attorney, 425 East Water street, represents the organizers of the company, whose identity is being withheld for the present.

The Central Brake Shoe & Foundry Co., 332 South Michigan avenue, Chicago, has been incorporated to manufacture and deal in brake shoes, machinery, etc., by Frank Van Inwagen, M. Van Inwagen and H. Van Inwagen. The company is represented by R. E. Schreiber, Otis building.

Capitalized at $10,000 the Excelsior Die Casting Co., 1812 Allen street, Chicago, recently was incorporated to manufacture and deal in die castings, etc., by Frederick Maas, John Strzelecki and Irving Weinstein. The company is represented by Dethlof C. Hansen, 432 Center street.

Articles of incorporation have been filed by the Lincoln Foundry Co., Laporte, Ind., which recently was organized to engage in a general foundry and machine shop business, by George H. Rawlinson, Andrew Mauderson, Frank Golick, Thomas F. Lewis and Ben C. Ross. The company has leased the plant of the Traction Machine & Foundry Co.

The Alton Foundry Co., 506 Shield street, Alton, Ill., recently was incorporated with a capital stock of $25,000 to manufacture and deal in brass, bronze, gray iron and aluminum castings, by Florence Alfred, William Alfred, Anthony J. Stolze, Alfred V. Degrand and Joseph W. Myers. The company is represented by William H. Feldwisch, 625 East Broadway.

Horace R. Simms, president of the Simms Foundry Corp., Racine, Wis., appears as the principal incorporator of the Simms Ferro Casting Co., a new Racine concern having a capital of 1000 shares of non-par common and $40,000 preferred stock. The Simms company a year ago took over another foundry plant in Racine, which will be operated by the new company.

The Willys Overland Co., Toledo, O., has authorized the expenditure of $450,000 on an addition to the Wilson Foundry & Machine Co., Pontiac, Mich. The plans include an addition to the assembly plant and milling room where engines are made and will increase the output of engines to 500 daily. The addition will be ready by July 30. The plans call for purchases of many boring and milling machines which will cost approximately $175,000.

Erection of an addition to its brass foundry is planned by the E. T. Fraim Lock Co., Lancaster, Pa. The building will be of modern foundry construction, of brick, steel and concrete. One wing will be utilized as a fireproof pattern vault. The wing on the opposite side of the structure will be used as a power house and will contain the fan and positive pressure blowers for the brass and iron melting furnaces, as well as some special machinery.

The Stewart-Warner Mfg. Co., Chicago, has sold its South Beliot, Wis., malleable foundry to the Wanner Malleable Castings Co. of Hammond, Ind., which thereby increases its production space to 325,000 square feet and capacity to 130 tons of finished castings daily. The Beliot plant has been idle for some time past but will start melting iron within a few days. H. C. Wanner, president of the Hammond company, is personally supervising the re-opening of the Beliot works.

Owing to the abnormal cost of labor, materials and general construction, and the uncertainty of tax legislation in Wisconsin, the Belle City Malleable Iron Co. of Racine, Wis., has cut down its plans in 1923 toward replacing its entire plant, work on which was started a year ago. The whole project involves the expenditure of $800,000. During the past year a new annealing building costing $200,000 was completed and work is now being started on a second building, 145 x 235 feet, which will house the corerooms, factory office and laboratories, and several minor departments. This will cost about $150,000. It has been planned to build a foundry at a cost of $450,000 this year, but the present shop will be kept in use until the spring of 1924. The annealing building contains one of four installations of Dressler continuous kilns, which are gas-fired.